U.S. Department of the Interior
U.S. Geological Survey

Aquifer Susceptibility in Virginia: Data on Chemical and Isotopic Composition, Recharge Temperature, and Apparent Age of Water from Wells and Springs, 1998-2000

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Virginia Department of Health
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By David L. Nelms and George E. Harlow, Jr.

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Richmond, Virginia
2003

U.S. DEPARTMENT OF THE INTERIOR
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CONVERSION FACTORS, DATUM, AND ABBREVIATED WATER-QUALITY UNITS

Multiply	By	To obtain
Length		
inch (in.)	25.4	millimeter
inch (in.)	2.54	centimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
Area		
square mile (mi^2)	259.0	hectare
square mile (mi^2)	2.590	square kilometer
Volume		
gallon (gal)	3.785	liter
gallon (gal)	0.003785	cubic meter
Cubic inch	16.387	cubic centimeters
picocurie per liter	37.04	becquerel per liter
picocurie per liter	0.3135	tritium unit (TU)
ounce	28.35	gram
pound	0.4535	kilogram
picogram	$1x10^{-12}$	gram
femtogram	$1x10^{-15}$	gram

Water temperature is reported in degree Celsius (°C), which can be converted to degree Fahrenheit (°F) by the following equation: °F = 1.8 (°C) + 32

Stable isotope ratios are reported as δ values computed from the formula

$$\delta_x = \left(\frac{R_x}{R_{STD}} - 1\right)1{,}000$$

where R_x is the ratio of the isotopes measured in the sample and R_{STD} is the isotope ratio in the reference standard. The value of δ_x is in parts per thousand (per mil).

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29); horizontal coordinate information is referenced to the North American Datum of 1927 (NAD27).

Abbreviated water-quality units: Chemical concentration is reported in milligrams per liter (mg/L) or micrograms per liter (µg/L). Milligrams per liter is a unit expressing the concentration of chemical constituents in solution as weight (milligrams) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter. For concentrations less than 7,000 mg/L, the numerical value is the same as for concentrations in parts per million. Specific electrical conductance of water is reported in microsiemens per centimeter at 25 degrees Celsius (µS/cm).

Additional abbreviated units used in this report: L (liter), mL (milliliter), kg (kilogram), pg (picogram), fmol (femtomole), pptv (parts per trillion by volume), STP (standard temperature and pressure, 0 degrees Celsius and 1 atmosphere), cc/L (cubic centimeters per liter).

Aquifer Susceptibility in Virginia: Data on Chemical and Isotopic Composition, Recharge Temperature, and Apparent Age of Water from Wells and Springs, 1998-2000

By David L. Nelms and George E. Harlow, Jr.

ABSTRACT

The determination of aquifer susceptibility to contamination from near-surface sources by the use of ground-water dating techniques is a critical part of Virginia's Source Water Assessment Program. As part of the Virginia Aquifer Susceptibility study, water samples were collected between 1998 and 2000 from 145 wells and 6 springs in various hydrogeologic settings across the Commonwealth. Samples were analyzed to determine water chemistry–including nitrate (NO_3), dissolved organic carbon (DOC), and radon-222 (^{222}Rn), major dissolved and noble gases–nitrogen (N_2), argon (Ar), oxygen (O_2), carbon dioxide (CO_2), methane (CH_4), helium (He), and neon (Ne), environmental tracers–chlorofluorocarbons (CFCs), sulfur hexafluoride (SF_6), tritium (^3H), and tritium/helium-3 ($^3H/^3He$), carbon isotopes–carbon-14 (^{14}C) and carbon-13 ($\delta^{13}C$), and stable isotopes of oxygen ($\delta^{18}O$) and hydrogen (δ^2H). The chemical and isotopic composition, recharge temperatures, and apparent ages of these water samples are presented in this report. Data collected between 1999 and 2000 from 18 wells in Virginia as part of two other studies by the U.S. Geological Survey also are presented. Most of the sites sampled serve as public water supplies and are included in the comprehensive Source Water Assessment Program for the Commonwealth.

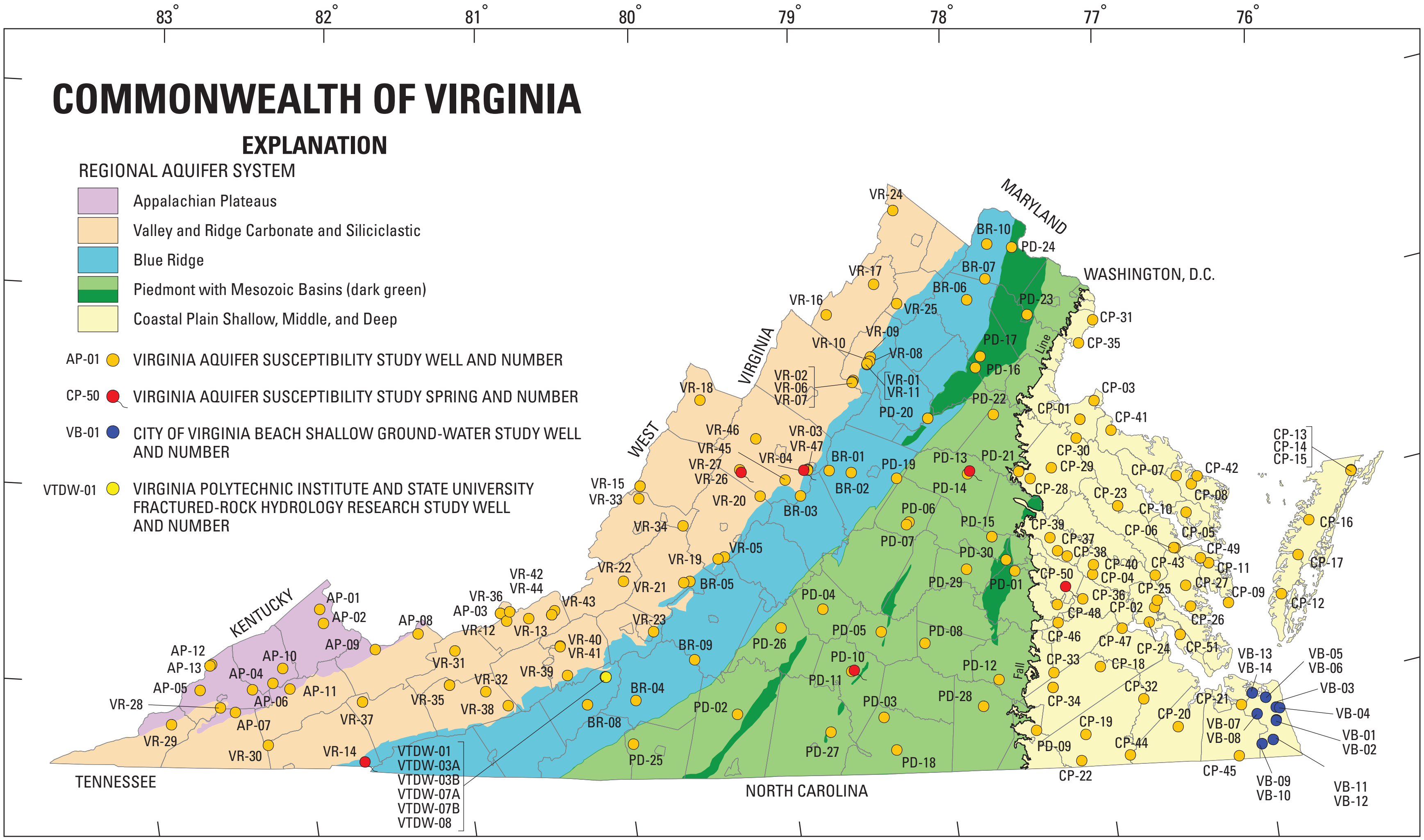
INTRODUCTION

The U.S. Geological Survey (USGS), in cooperation with the Virginia Department of Health (VDH), conducted the Virginia Aquifer Susceptibility (VAS) study between 1998 and 2000 to determine the susceptibility to contamination from near-surface sources of the regional aquifers in Virginia that serve as public water supplies (Harlow and others, 1999). Water samples were collected from 145 wells and 6 springs in various hydrogeologic settings across the Commonwealth (fig. 1). Multiple environmental tracers–chlorofluorocarbons (CFCs), sulfur hexafluoride (SF_6), tritium (^3H), and tritium/helium-3 ($^3H/^3He$) and carbon isotopes–carbon-14 (^{14}C) and carbon-13 ($\delta^{13}C$) were used to estimate the age of water discharging from wells and springs. Most of these wells and springs are regulated as public water supplies and are classified as community, transient non-community, or non-transient non-community systems on the basis of type of water usage and population served.

The Federal Safe Drinking Water Act (SDWA) Amendments of 1996 require each state to develop and implement a comprehensive Source Water Assessment Program (SWAP). The VAS study is part of the Commonwealth of Virginia's SWAP, which is coordinated by the VDH, Office of Drinking Water (Virginia Department of Health, 1999). The premise of the VAS study was that ground-water age determinations can be used as a guide for classifying regional aquifer systems in terms of their susceptibility to near-surface contamination. The information from the VAS study will be used by VDH (1) to determine which water supplies are sensitive to contamination from near-surface sources, and (2) to identify public ground-water supplies that require detailed source water assessments.

Purpose and Scope

The purpose of this report is to present data collected during the VAS study from 1998 to 2000 across the Commonwealth. Additional data that were collected by the USGS between 1999 and 2000 to supplement the VAS data are presented: (1) the USGS's Virginia Beach Shallow Ground-Water study, in coop-



Province boundaries modified from Virginia Division of Mineral Resources (2003).

Figure 1. Location of wells and springs sampled in Virginia, 1998-2000.

eration with the City of Virginia Beach (Johnson, 1999) and (2) Virginia Polytechnic Institute and State University's (VPI&SU) fractured-rock hydrology research project in Floyd County, Va. The chemical composition of water from the wells and springs sampled is represented by data for water-quality field properties (dissolved oxygen, water temperature, pH, and specific conductance), major-, minor- (including nitrate (NO_3), dissolved organic carbon (DOC), and radon-222 (^{222}Rn)), and trace-element chemistry, and by data for major dissolved and noble gases (nitrogen (N_2), argon (Ar), oxygen (O_2), carbon dioxide (CO_2), methane (CH_4), helium (He), and neon (Ne)). The isotopic composition is represented by data for the stable isotopes of oxygen ($\delta^{18}O$) and hydrogen ($\delta\,^{2}H$). Recharge temperature estimates from N_2-Ar data and quantities of excess air from N_2-Ar and Ne data are presented. Apparent ages of the water samples presented in this report were estimated from multiple environmental tracers (CFCs, SF_6, ^3H, and $^3H/^3He$) and ^{14}C.

Definition of Apparent Age

The term "apparent age", as defined by Plummer and Busenberg (2000), is used throughout this report because the model age approximates the time elapsed since a water sample was isolated from air in the unsaturated zone during recharge and is based on an interpretation of measured concentrations of environmental tracers in ground water. Chemical (sorption and biodegradation) and physical (mixing) processes can alter the concentrations of the tracers in ground water and thus the model ages (Plummer and Busenberg, 2000). The apparent age represents estimates from the individual environmental tracer and does not constitute the final age assigned for the water sample. The final ages will be presented in the interpretive publication.

Sampling Locations

Public water supplies were the primary focus of the VAS study. Sites were selected on the basis of (1) their geographic position within the Commonwealth and within the respective geologic province, (2) the availability of well-construction information, and (3) their accessibility (fig. 1). Additional sites (19 wells and 1 spring) that are not classified as public water supplies also were selected based on unique characteristics. For example, the public water supply data base did not contain any springs located in the Virginia Coastal Plain for the duration of the VAS study; therefore, spring CP-50 was selected to assess the susceptibility to contamination of springs in the Coastal Plain.

For the purpose of this study, the Commonwealth was subdivided into eight regional aquifer systems on the basis of (1) physiographic province (Fenneman, 1938), (2) geologic province, and (3) hydrogeologic characteristics; as well as (4) major rock type (Valley and Ridge province), and (5) depth of the top of the first screened interval (Coastal Plain province). These regional aquifer systems are:

1. Appalachian Plateaus,
2. Valley and Ridge Carbonate,
3. Valley and Ridge Siliciclastic,
4. Blue Ridge,
5. Piedmont (including the Mesozoic Basins),
6. Coastal Plain-Shallow (depths less than 200 feet below land surface),
7. Coastal Plain-Middle (depths between 200 and 400 ft below land surface), and
8. Coastal Plain-Deep. (depths greater than 400 ft below land surface).

The carbonate rocks in the Valley and Ridge province have different hydrogeologic characteristics (karst topography, solution channels, and caves) from the siliciclastic rocks (sandstone, shale, and siltstone). In the Coastal Plain province, the wedge-like geometry of the deposits results in multiple regional aquifer system designations for a single aquifer (fig. 2) based on hydrogeologic setting (Nelms and Harlow, 2000). For example, the Middle Potomac aquifer is initially assigned to the Coastal Plain-Shallow system near the Fall Line. As the aquifer progressively becomes deeper towards the east and less connected to hydrologic and anthropogenic activities at the surface, the designation changes; the Middle Potomac aquifer is assigned to all three of the Coastal Plain regional aquifer systems (fig. 2). The distribution of sites sampled during the VAS study by regional aquifer system and aquifer is summarized in table 1.

Site and construction information for wells and springs sampled between 1998 and 2000 are summarized in table 2. Latitudes and longitudes were deter-

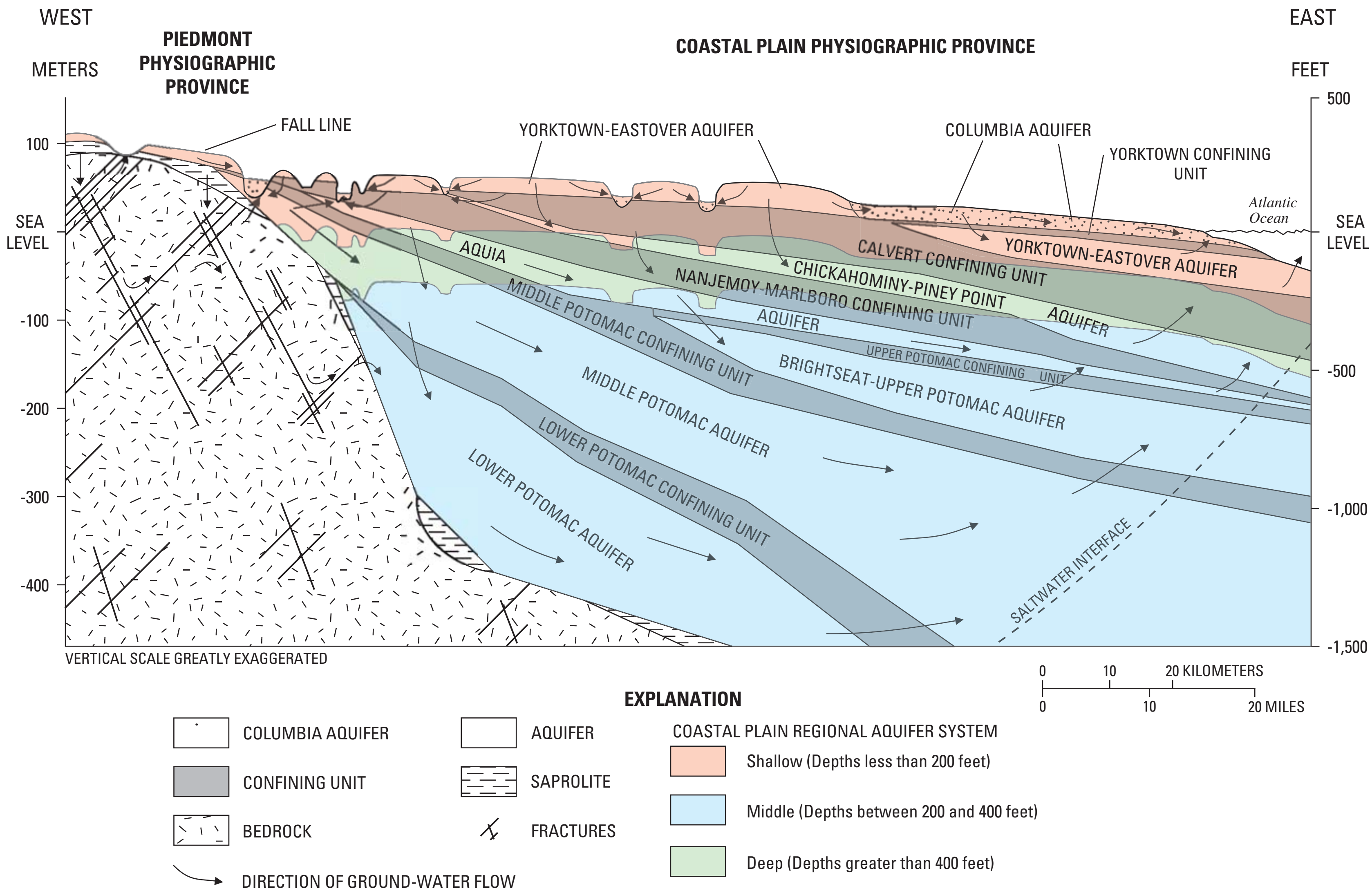


Figure 2. Generalized hydrogeologic section representing conceptualization of the Virginia Coastal Plain Province as vertically layered aquifers and confining units and the regional aquifer system classification used during the Virginia Aquifer Susceptibility study (Modified from McFarland, 1999).

Table 1. Distribution of wells and springs sampled as part of the Virginia Aquifer Susceptibility study by regional aquifer system and aquifer, 1998-2000

APPALACHIAN PLATEAUS

Aquifer	No.
Bluefield	1
Lee	1
New River	1
Norton	7
Pennington Gap	1
Wise	2
Total	**13**

VALLEY AND RIDGE

Carbonate

Aquifer	No.
Conococheague	7
Elbrook	3
Knox	1
Martinsburg	1
Middle Ordovician	1
Reedsville/Eggleston/Moccasin	1
Rome	3
Shady	3
Waynesboro	1
Total	**21**

Siliciclastic

Aquifer	No.
Brallier	4
Chattanooga	1
Chemung	2
Devonian/Silurian	2
Granite	1
Huntersville	1
Millboro	4
Millboro/Needmore	1
Missippian Fms. Undiv	1
Moccasin/Bays	1
Reedsville/Eggleston/Moccasin	1
Rome	4
Rose Hill	1
Waynesboro	1
Total	**25**

BLUE RIDGE

Augen gneiss	6
Catoctin	1
Elbrook	1
Granite	1
Granite Gneiss	4
Marshall	2
Metamorphosed Sedimentary Rocks	1
Shady	1
Total	**17**

PIEDMONT

Amphibolite and Amphibolite rich foliats	2
Balls Bluff	3
Biotite gneiss	2
Everona	1
Fork Mountain	1
Garnet-biotite gneiss	1
Granite	1
Granite Gneiss	7
Jurassic System	1
Manassas	1
Metamorphosed Sedimentary Rocks	2
Metamorphosed Volcanic and Sedimentary Rocks	3
nd	1
Newark	1
Ordovician System	1
Petersburg	1
Vinita	1
Total	**30**

COASTAL PLAIN[1]

Shallow (depths less than 200 ft)	
Columbia	9
Yorktown-Eastover	20
Chickahominy/Piney Point	1
Virginia Beach	1
Middle Potomac	2
Granite Gneiss	1
Total	**34**

Middle (depths between 200 and 400 ft)	
Chickahominy/Piney Point	7
Aquia	1
Upper Potomac	2
Middle Potomac	9
Lower Potomac	1
Total	**20**

Deep (depths greater than 400 ft)	
Upper Potomac	2
Middle Potomac	8
Lower Potomac	1
Total	**11**

[1] Depths are below land surface and aquifer system designation for a particular site sampled is based on the depth below land surface of the top of the first screened interval.

Table 2. Site and well-construction information for wells and springs sampled in Virginia, 1998-2000

[VAS, Virginia Aquifer Susceptibility study; USGS, U.S. Geological Survey; Latitude and longitude in degrees, minutes, seconds in NAD27 datum; Alt., altitude of land surface, datum is sea level NGVD29; ft, feet; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	USGS local no.	USGS site identifier	Public water supply no.	County/ City	Project[1]	Site type	Type of system[2]	Latitude	Longitude	Alt. (ft)	Date of construction	Well depth (ft-blsd)	Casing depth (ft-blsd)	Grout depth (ft-blsd)	Sample interval Top (ft-blsd)	Sample interval Bottom (ft-blsd)	Number of water zones	Water zone type	Aquifer type	Regional aquifer system[3]
AP-01	14H 4	372249082000501	VA1027236	Buchanan	VAS	Well	NTNC	372249	820005	1,130	nd	nd	nd	nd	nd	nd	nd	nd	Norton	AP
AP-02	15G 19	371841081584201	VA1027270	Buchanan	VAS	Well	NTNC	371841	815842	1,440	nd	nd	nd	nd	nd	nd	nd	nd	Norton	AP
AP-03	24G 2	372155080514501	VA1071260	Giles	VAS	Well	C	372155	805145	1,735	12/15/1980	855.0	63.0	63.0	300.0	655.0	2	Fracture	Bluefield	AP
AP-03d	24G 2	372155080514501	VA1071260	Giles	VAS	QA-Dup	C	372155	805145	1,735	12/15/1980	855.0	63.0	63.0	300.0	655.0	2	Fracture	Bluefield	QA
AP-04	12E 5	370049082171501	VA1051785	Dickenson	VAS	Well	C	370049	821715	1,840	12/29/1970	222.0	118.5	118.5	118.5	222.0	1	Open Hole	Norton	AP
AP-05	09D 2	365814082444001	VA1195200	Wise	VAS	Well	C	365814	824440	1,940	1/1/1900	250.0	40.0	nd	40.0	250.0	1	Open Hole	Wise	AP
AP-06	11D 15	365842082250601	VA1195170	Wise	VAS	Well	C	365842	822506	2,340	4/6/1965	204.0	nd	nd	nd	nd	nd	nd	Norton	AP
AP-07	10C 2	365203082312601	VA1169011	Scott	VAS	Well	NC	365203	823126	2,780	12/8/1963	119.0	50.0	50.0	50.0	119.0	1	Open Hole	Lee	AP
AP-08	19G 1	371546081224501	VA1185065	Tazewell	VAS	Well	C	371546	812245	2,710	4/8/1976	298.0	52.0	50.0	75.0	298.0	3	Fracture	Pennington Gap	AP
AP-09	17F 2	371104081385001	VA1185010	Tazewell	VAS	Well	C	371104	813850	1,735	2/1/1996	245.0	105.0	103.0	117.0	151.0	2	Fracture	New River	AP
AP-10	13E 13	370507082134201	VA1051425	Dickenson	VAS	Well	NTNC	370507	821342	1,560	10/2/1978	305.0	50.0	50.0	50.0	305.0	1	Open Hole	Norton	AP
AP-11	13D 5	365912082105601	VA1167450	Russell	VAS	Well	NTNC	365912	821056	1,755	9/26/1991	180.0	120.0	120.0	135.0	150.0	1	Fracture	Norton	AP
AP-12	09E 10	370604082403901	VA1195140	Wise	VAS	Well	NC	370604	824039	1,660	nd	201.0	50.0	50.0	50.0	201.0	1	Open Hole	Norton	AP
AP-13	09E 11	370536082411301	VA1195099	Wise	VAS	Well	NC	370536	824113	1,670	nd	125.0	50.0	50.0	50.0	125.0	1	Open Hole	Wise	AP
BR-01	40N 4	380244078460201	VA2003350	Albermarle	VAS	Well	NC	380244	784602	750	12/7/1976	300.0	51.0	51.0	165.0	165.0	1	Fracture	Granite	BR
BR-02	41N 5	380206078374701	VA2003351	Albermarle	VAS	Well	NC	380206	783747	690	10/21/1969	400.0	69.0	69.0	144.0	385.0	5	Fracture	Granite Gneiss	BR
BR-03	39M 3	375530078572101	VA2125910	Nelson	VAS	Well	C	375530	785721	3,440	4/21/1977	335.0	58.0	58.0	68.0	268.0	4	Fracture	Catoctin	BR
BR-04	30D 1	365543080004901	VA5067120	Franklin	VAS	Well	C	365544	800049	1,290	10/25/1968	330.0	85.0	85.0	100.0	300.0	3	Fracture	Granite Gneiss	BR
BR-05	33J 1	373053079395901	VA2023160	Botetourt	VAS	Well	C	373052	793958	1,040	1/1/1935	376.0	44.0	nd	44.0	376.0	1	Open Hole	Shady	BR
BR-06	48U 25	385211077513301	VA6061200	Fauquier	VAS	Well	C	385211	775133	660	5/3/1976	310.0	53.0	53.0	124.0	270.0	2	Fracture	Marshall	BR
BR-07	49V 91	385814077440501	VA6107450	Loudoun	VAS	Well	C	385814	774405	490	12/12/1986	685.0	56.0	57.0	100.0	645.0	1	Fracture	Marshall	BR
BR-08	28D 4	365439080190101	VA1063220	Floyd	VAS	Well	C	365439	801901	2,450	6/7/1980	350.0	50.0	50.0	55.0	316.0	3	Fracture	Granite Gneiss	BR
BR-09	33F 1	370735079383701	nd	Bedford	VAS	Well	C	370735	793837	940	nd	nd	nd	nd	nd	nd	nd	nd	Metamorphosed Sedimentary Rocks	BR
BR-10	49X 10	390832077430001	VA6107600	Loudoun	VAS	Well	C	390832	774300	500	9/22/1966	280.0	79.0	79.0	90.0	164.0	3	Fracture	Granite Gneiss	BR
CP-01	53Q 21	381536077095201	VA6099050	King George	VAS	Well	C	381536	770952	190	3/1/1987	782.0	662.0	100.0	662.0	721.0	2	Screen	Middle Potomac	CP-D
CP-01d	53Q 21	381536077095201	VA6099050	King George	VAS	QA-Dup	C	381536	770952	190	3/1/1987	782.0	662.0	100.0	662.0	721.0	2	Screen	Middle Potomac	QA
CP-02	57G 57	371900076442701	VA3095490	James City	VAS	Well	C	371900	764429	111	5/1/1967	302.0	282.0	50.0	282.0	302.0	1	Screen	Chickahominy/ Piney Point	CP-M
CP-03	54Q 91	382046077035501	VA6099295	King George	VAS	Well	C	382052	770401	20	11/18/1976	676.0	641.0	50.0	641.0	671.0	1	Screen	Middle Potomac	CP-D
CP-04	54H 13	372949077072101	VA4127925	New Kent	VAS	Well	C	372941	770725	110	1/17/1972	370.0	304.0	100.0	304.0	364.0	3	Screen	Upper Potomac	CP-M
CP-05	58J 1	373630076361201	VA4119600	Middlesex	VAS	Well	C	373620	763541	90	5/4/1942	330.0	300.0	nd	298.0	320.0	3	Screen	Chickahominy/ Piney Point	CP-M
CP-06	58J 12	373631076361201	VA4119600	Middlesex	VAS	Well	C	373631	763612	90	5/5/1983	644.0	565.0	100.0	565.0	634.0	2	Screen	Upper Potomac	CP-D

Table 2. Site and well-construction information for wells and springs sampled in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; USGS, U.S. Geological Survey; Latitude and longitude in degrees, minutes, seconds in NAD27 datum; Alt., altitude of land surface, datum is sea level NGVD29; ft, feet; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	USGS local no.	USGS site identifier	Public water supply no.	County/City	Project[1]	Site type	Type of system[2]	Latitude	Longitude	Alt. (ft)	Date of construction	Well depth (ft-blsd)	Casing depth (ft-blsd)	Grout depth (ft-blsd)	Sample interval Top (ft-blsd)	Sample interval Bottom (ft-blsd)	Number of water zones	Water zone type	Aquifer type	Regional aquifer system[3]
CP-07	58M 4	375744076335001	VA4133160	Northumberland	VAS	Well	C	375744	763350	98	6/6/1983	360.0	nd	334.0	334.0	360.0	1	Screen	Chickahominy/ Piney Point	CP-M
CP-08	59M 5	375502076281801	VA4133360	Northumberland	VAS	Well	C	375504	762819	100	10/15/1946	448.0	412.0	nd	412.0	438.0	1	Screen	Chickahominy/ Piney Point	CP-M
CP-09	60G 4	371925076162702	VA4115400	Mathews	VAS	Well	C	371925	761627	5	6/17/1991	153.0	118.0	100.0	118.0	148.0	1	Screen	Yorktown-Eastover	CP-S
CP-10	58L 2	374641076305001	VA4103800	Lancaster	VAS	Well	C	374643	763049	103	1/1/1946	365.0	nd	nd	344.0	354.0	nd	nd	Chickahominy/ Piney Point	CP-M
CP-11	59J 7	373126076231701	VA4115450	Mathews	VAS	Well	C	373127	762316	25	8/1/1963	114.0	92.2	nd	92.2	114.0	1	Screen	Yorktown-Eastover	CP-S
CP-11b	59J 7	373126076231701	VA4115450	Mathews	VAS	QA-Blank	nd	373127	762316	25	8/1/1963	114.0	92.2	nd	92.2	114.0	1	Screen	Yorktown-Eastover	QA
CP-12	63G 37	372106075562001	VA3131200	Northampton	VAS	Well	C	372106	755621	38	9/15/1973	165.0	145.0	60.0	145.0	165.0	1	Screen	Yorktown-Eastover	CP-S
CP-13	67M 24	375639075285901	VA3001175	Accomack	VAS	Well	C	375638	752720	24	1/1/1965	245.0	216.0	nd	216.0	245.0	1	Screen	Yorktown-Eastover	CP-S
CP-14	67M 46	375626075272501	VA3001175	Accomack	VAS	Well	C	375626	752725	20	7/18/1989	59.0	44.0	39.0	44.0	59.0	1	Screen	Columbia	CP-S
CP-15	67M 9	375626075272301	VA3001175	Accomack	VAS	Well	C	375627	752724	19	4/29/1964	256.0	223.0	101.0	223.0	256.0	1	Screen	Yorktown-Eastover	CP-S
CP-16	65K 9	374233075443201	VA3001620	Accomack	VAS	Well	C	374234	754432	17	12/23/1952	159.0	100.0	nd	106.0	110.0	1	Screen	Yorktown-Eastover	CP-S
CP-17	64J 2	372235075533501	VA3131210	Northampton	VAS	Well	C	373230	754915	34	6/1/1950	190.0	160.0	nd	160.0	190.0	1	Screen	Yorktown-Eastover	CP-S
CP-18	54E 1	370200077054301	VA3183950	Sussex	VAS	Well	C	370205	770545	112	1/1/1932	230.0	200.0	nd	200.0	230.0	1	Screen	Upper Potomac	CP-M
CP-19	53B 8	364214077121701	VA3175170	Southampton	VAS	Well	C	364214	771217	120	2/19/1980	276.0	238.0	50.0	238.0	252.0	1	Screen	Middle Potomac	CP-M
CP-20	57B 7	363955076380001	VA3800370	Suffolk	VAS	Well	C	364321	763734	60	5/4/1962	645.0	621.0	nd	621.0	645.0	1	Screen	Middle Potomac	CP-D
CP-21	61C 34	364859076133301	VA3550500	Chesapeake	VAS	Well	C	364859	761333	15	3/15/1993	68.0	58.0	50.0	58.0	68.0	1	Screen	Columbia	CP-S
CP-22	53A 11	363424077143001	VA3175130	Southampton	VAS	Well	C	363429	771413	42	3/31/1975	290.0	236.0	75.0	236.0	286.0	2	Screen	Middle Potomac	CP-M
CP-23	55L 2	374932076564201	VA4057568	Essex	VAS	Well	C	374933	765636	170	12/5/1979	283.0	244.0	50.0	244.0	275.0	2	Screen	Chickahominy/ Piney Point	CP-M
CP-23d	55L 2	374932076564201	VA4057568	Essex	VAS	QA-Dup	C	374933	765636	170	12/5/1979	283.0	244.0	50.0	244.0	275.0	2	Screen	Chickahominy/ Piney Point	QA
CP-24	56F 19	371447076463501	VA3095490	James City	VAS	Well	C	371448	764637	33	7/16/1973	390.0	360.0	50.0	360.0	390.0	1	Screen	Middle Potomac	CP-D
CP-25	57G 60	372118076430401	VA3199730	York	VAS	Well	C	372106	764314	95	9/14/1977	324.0	302.0	50.0	298.0	324.0	1	Screen	Chickahominy /Piney Point	CP-M
CP-26	58G 87	371844076304501	VA4073311	Gloucester	VAS	Well	C	371844	763045	30	nd	55.0	55.0	nd	47.0	48.0	1	Screen	Columbia	CP-S
CP-27	58H 2	372458076321401	VA4073311	Gloucester	VAS	Well	C	372459	763215	77	8/1/1936	815.0	784.0	nd	784.0	815.0	2	Screen	Middle Potomac	CP-D
CP-28	51M 1	375840077292701	VA6033300	Caroline	VAS	Well	NC	375840	772931	200	9/15/1975	445.0	50.0	50.0	75.0	445.0	4	Fracture	Granite Gneiss	CP-S
CP-29	52N 17	380139077212901	VA6033500	Caroline	VAS	Well	C	380139	772129	175	4/26/1973	295.0	262.0	275.0	262.0	292.0	1	Screen	Middle Potomac	CP-M
CP-30	53P 5	381007077113101	VA6033600	Caroline	VAS	Well	C	381007	771131	26	3/16/1942	317.0	300.0	nd	299.0	308.0	1	Screen	Middle Potomac	CP-M
CP-31	54T 19B	384453077031801	VA6059750	Fairfax	VAS	Well	C	384453	770318	110	6/28/1955	286.7	238.0	nd	238.0	277.0	2	Screen	Middle Potomac	CP-M
CP-32	56C 8	365205076495701	VA3093950	Isle of Wight	VAS	Well	C	365205	764957	35	9/5/1992	350.0	340.0	50.0	340.0	350.0	1	Screen	Middle Potomac	CP-M
CP-33	51E 4	370100077232701	VA3053600	Dinwiddie	VAS	Well	NC	370100	772327	98	1/0/1900	160.0	135.0	50.0	135.0	160.0	1	Screen	Middle Potomac	CP-S
CP-34	51D 2	365635077235101	VA3183750	Sussex	VAS	Well	C	365635	772351	76	8/16/1988	88.0	62.0	50.0	62.0	82.0	1	Screen	Middle Potomac	CP-S
CP-34d	51D 2	365635077235101	VA3183750	Sussex	VAS	QA-Dup	C	365635	772351	76	8/16/1988	88.0	62.0	50.0	62.0	82.0	1	Screen	Middle Potomac	QA
CP-35	53T 30	383814077090301	VA6059200	Fairfax	VAS	Well	C	383814	770902	40	5/10/1963	464.0	434.0	nd	434.0	464.0	2	Screen	Lower Potomac	CP-D
CP-36	53G 20	372224077112401	VA4036900	Charles City	VAS	Well	C	372224	771124	85	4/25/1980	300.0	220.0	50.0	220.0	250.0	1	Screen	Middle Potomac	CP-M
CP-37	52J 55	373651077201701	VA4085398	Hanover	VAS	Well	C	373651	772017	170	7/17/1989	413.0	320.0	100.0	320.0	408.0	2	Screen	Middle Potomac	CP-M

Table 2. Site and well-construction information for wells and springs sampled in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; USGS, U.S. Geological Survey; Latitude and longitude in degrees, minutes, seconds in NAD27 datum; Alt., altitude of land surface, datum is sea level NGVD29; ft, feet; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	USGS local no.	USGS site identifier	Public water supply no.	County/ City	Project[1]	Site type	Type of system[2]	Latitude	Longitude	Alt. (ft)	Date of construction	Well depth (ft-blsd)	Casing depth (ft-blsd)	Grout depth (ft-blsd)	Sample interval Top (ft-blsd)	Sample interval Bottom (ft-blsd)	Number of water zones	Water zone type	Aquifer type	Regional aquifer system[3]
CP-38	52J 54	373522077163701	VA4085398	Hanover	VAS	Well	C	373522	771637	190	4/9/1993	487.0	357.0	300.0	357.0	482.0	1	Screen	Middle Potomac	CP-D
CP-39	51K 23	374050077230201	VA4085650	Hanover	VAS	Well	C	374050	772302	155	5/11/1978	260.0	240.0	50.0	240.0	260.0	1	Screen	Lower Potomac	CP-M
CP-40	54J 5	373207077064701	VA4127430	New Kent	VAS	Well	C	373229	770649	152	3/1/1974	470.0	399.0	53.0	399.0	466.0	2	Screen	Middle Potomac	CP-D
CP-41	55P 11	381158076575301	VA4193120	Westmoreland	VAS	Well	C	381158	765753	25	8/18/1958	216.0	206.0	nd	206.0	216.0	1	Screen	Aquia	CP-M
CP-42	59M 6	375716076255401	VA4133040	Northumberland	VAS	Well	C	375716	762554	23	7/28/1964	616.0	596.0	nd	596.0	616.0	1	Screen	Upper Potomac	CP-D
CP-43	57H 23	372823076433601	VA4097720	King & Queen	VAS	Well	C	372823	764336	6	8/8/1987	208.0	190.0	nd	190.0	208.0	1	Screen	Chickahominy/ Piney Point	CP-S
CP-44	55A 4	363540076560001	VA3175750	Southampton	VAS	Well	C	363540	765600	25	2/21/1986	182.0	172.0	50.0	172.0	182.0	1	Screen	Virginia Beach	CP-S
CP-45	60A 21	363351076152601	VA3550620	Chesapeake	VAS	Well	C	363351	761526	22	8/10/1993	69.0	54.0	50.0	54.0	69.0	1	Screen	Columbia	CP-S
CP-46	52G 32	371554077210501	VA3149630	Prince George	VAS	Well	C	371544	772105	113	4/3/1981	95.0	70.0	50.0	70.0	80.0	1	Screen	Columbia	CP-S
CP-47	55F 21	371322076570801	VA3181250	Surry	VAS	Well	C	371322	765708	95	3/13/1995	385.0	308.0	100.0	308.0	380.0	3	Screen	Middle Potomac	CP-M
CP-48	52G 33	372059077210501	VA4041065	Chesterfield	VAS	Well	C	372059	772105	129	nd	90.0	90.0	nd	90.0	90.0	nd	nd	Columbia	CP-S
CP-49	59J 12	373304076261701	VA4119870	Middlesex	VAS	Well	NTNC	373304	762617	65	nd	104.0	84.0	50.0	84.0	104.0	1	Screen	Yorktown-Eastover	CP-S
CP-50	52HS 1	372615077175701	nd	Hanover	VAS	Spring	nd	372615	771757	95	nd	nd	nd	nd	nd	nd	nd	nd	Columbia	CP-S
CP-51	58F 89	371041076351703	nd	Newport News	VAS	Well	C	371043	763517	30	1/20/1997	1,131.0	1,020.0	582.0	1,020.0	1,130.0	2	Screen	Middle Potomac	CP-D
CP-51d	58F 89	371041076351703	nd	Newport News	VAS	QA-Dup	C	371043	763517	30	1/20/1997	1,131.0	1,020.0	582.0	1,020.0	1,130.0	2	Screen	Middle Potomac	QA
PD-01	50J 10	373133077364701	nd	Chesterfield	VAS	Well	I	373133	773647	362	8/20/1998	950.0	101.0	21.0	200.0	950.0	3	Fracture	Petersburg	PD
PD-02	35C 1	365110079224301	VA5143700	Pittsylvania	VAS	Well	C	365110	792243	775	4/27/1972	425.0	104.0	104.0	135.0	374.0	3	Fracture	Granite Gneiss	PD
PD-03	43C 1	364917078275401	VA5117200	Mecklenburg	VAS	Well	C	364917	782754	558	11/14/1980	385.0	123.0	nd	123.0	360.0	4	Fracture	Metamorphosed Volcanic and Sedimentary Rocks	PD
PD-04	40G 2	372156078494801	VA5011050	Appomattox	VAS	Well	C	372156	784948	860	7/26/1996	410.0	82.0	80.0	333.0	336.0	1	Fracture	Granite Gneiss	PD
PD-05	43F 1	371439078275101	VA5147280	Prince Edward	VAS	Well	C	371439	782754	500	9/15/1940	528.0	100.0	nd	100.0	528.0	nd	nd	Granite Gneiss	PD
PD-06	44L 1	374651078161601	VA2065300	Fluvanna	VAS	Well	C	374651	781616	355	11/10/1981	505.0	68.0	68.0	125.0	400.0	2	Fracture	Ordovician System	PD
PD-07	44L 2	374610078172001	VA2065300	Fluvanna	VAS	Well	C	374610	781720	415	12/3/1977	305.0	77.0	77.0	90.0	225.0	1	Fracture	Metamorphosed Sedimentary Rocks	PD
PD-08	45F 1	371054078114201	VA5135110	Nottoway	VAS	Well	C	371054	781142	480	6/28/1967	285.0	121.0	65.0	190.0	230.0	1	Fracture	Granite	PD
PD-09	50B 2	364409077303801	VA3081900	Greensville	VAS	Well	C	364409	773038	120	8/4/1993	345.0	51.0	51.0	94.0	316.0	5	Fracture	Metamorphosed Volcanic and Sedimentary Rocks	PD
PD-10	41ES 1	370330078382601	VA5037150	Charlotte	VAS	Spring	C	370330	783826	535	nd	nd	nd	nd	nd	nd	nd	nd	Granite Gneiss	PD
PD-11	41E 1	370311078390201	VA5037150	Charlotte	VAS	Well	C	370311	783902	555	9/29/1959	200.0	103.5	nd	116.0	116.0	1	Fracture	Granite Gneiss	PD
PD-12	49D 1	365924077441601	VA3053700	Dinwiddie	VAS	Well	C	365925	774417	220	11/8/1968	145.0	72.0	72.0	72.0	132.0	1	Open Hole	Mylonite	PD
PD-13	47NS 1	380124077524801	VA2109525	Louisa	VAS	Spring	C	380124	775248	360	nd	nd	nd	nd	nd	nd	nd	nd	Amphibolite and Amphibolite rich foliats	PD
PD-14	47N 5	380046077531801	VA2109525	Louisa	VAS	Well	C	380046	775318	430	10/12/1956	211.0	98.0	nd	98.0	211.0	1	Open Hole	Amphibolite and Amphibolite rich foliats	PD
PD-15	49K 2	374159077445901	VA4075390	Goochland	VAS	Well	NC	374158	774502	350	12/23/1968	370.0	50.0	50.0	84.0	114.0	3	Fracture	Granite Gneiss	PD

Table 2. Site and well-construction information for wells and springs sampled in Virginia, 1998-2000—Continued

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VAS no.	USGS local no.	USGS site identifier	Public water supply no.	County/ City	Project[1]	Site type	Type of system[2]	Latitude	Longitude	Alt. (ft)	Date of construction	Well depth (ft-blsd)	Casing depth (ft-blsd)	Grout depth (ft-blsd)	Sample interval Top (ft-blsd)	Sample interval Bottom (ft-blsd)	Number of water zones	Water zone type	Aquifer type	Regional aquifer system[3]
PD-15d	49K 2	374159077445901	VA4075390	Goochland	VAS	QA-Dup	NC	374158	774502	350	12/23/1968	370.0	50.0	50.0	84.0	114.0	3	Fracture	Granite Gneiss	QA
PD-16	48S 20H	383207077485001	VA6061500	Fauquier	VAS	Well	C	383159	774902	290	9/25/1971	281.0	51.5	51.5	165.0	250.0	6	Fracture	Balls Bluff	PD
PD-17	48S 37	383515077470201	VA6061129	Fauquier	VAS	Well	C	383515	774702	325	7/21/1994	500.0	56.0	52.0	400.0	440.0	2	Fracture	Jurassic System	PD
PD-18	43B 1	363942078231301	VA5117100	Mecklenburg	VAS	Well	C	363942	782313	315	5/17/1963	240.0	50.0	50.0	157.0	190.0	2	Fracture	Metamorphosed Volcanic and Sedimentary Rocks	PD
PD-19	44N 2	380001078203401	VA2003400	Albermarle	VAS	Well	C	380001	782034	400	12/1/1985	305.0	53.0	53.0	105.0	223.0	2	Fracture	Everona	PD
PD-20	45Q 1	381735078075001	VA6113300	Madison	VAS	Well	C	381735	780750	390	3/19/1986	145.0	54.0	50.0	64.0	117.0	3	Fracture	Manassas	PD
PD-20b	45Q 1	381735078075001	nd	Madison	VAS	QA-Blank	nd	381735	780750	390	nd	nd	nd	nd	nd	nd	nd	nd	nd	QA
PD-21	50N 4	380046077340401	VA6033450	Caroline	VAS	Well	C	380046	773404	295	3/10/1973	475.0	150.0	52.0	243.0	463.0	3	Fracture	Granite Gneiss	PD
PD-22	49Q 2	381802077425401	VA6177252	Spotsylvania	VAS	Well	C	381802	774254	425	10/10/1970	303.0	54.0	54.0	120.0	230.0	2	Fracture	Metamorphosed Sedimentary Rocks	PD
PD-23	51U103G	384702077283401	VA6687100	Prince William	VAS	Well	C	384705	772831	175	11/24/1971	925.0	50.0	50.0	310.0	609.0	4	Fracture	Balls Bluff	PD
PD-24	50W 7B	390711077332501	VA6107300	Loudoun	VAS	Well	C	390711	773325	345	12/1/1962	400.0	51.0	51.0	57.0	230.0	3	Fracture	Balls Bluff	PD
PD-25	30B 1	364248080015201	VA5089945	Henry	VAS	Well	C	364248	800152	1,085	1/1/1972	250.0	142.0	nd	142.0	143.0	1	Fracture	Biotite gneiss	PD
PD-26	38G 1	371635079054401	VA5031800	Campbell	VAS	Well	C	371635	790544	875	7/4/1984	360.0	102.0	102.0	265.0	270.0	1	Fracture	Fork Mountain	PD
PD-27	40C 1	364523078475401	VA5083690	Halifax	VAS	Well	C	364523	784754	360	10/19/1977	280.0	105.0	105.0	105.0	280.0	1	Fracture	Newark	PD
PD-28	48C 3	365146077502201	VA5025319	Brunswick	VAS	Well	NC	365146	775022	318	1/13/1992	345.0	52.0	52.0	190.0	305.0	2	Fracture	Biotite gneiss	PD
PD-29	47J 2	373230077545301	VA4145675	Powhatan	VAS	Well	C	373230	775454	335	2/22/1983	350.0	53.0	53.0	80.0	350.0	2	Fracture	Garnet-biotite gneiss	PD
PD-30	49J 4	373452077395401	VA4075400	Goochland	VAS	Well	C	373452	773954	258	2/16/1981	400.0	51.0	51.0	52.0	158.0	2	Fracture	Vinita	PD
VB-01	62B 8	364401076003801	nd	Virginia Beach	VBCH	Well	O	364401	760038	9	3/1/1981	132.0	117.0	115.0	117.0	127.0	1	Screen	Yorktown-Eastover	CP-S
VB-02	62B 9	364352076005401	nd	Virginia Beach	VBCH	Well	O	364352	760054	11	2/1/1981	67.0	52.0	50.0	52.0	62.0	1	Screen	Yorktown-Eastover	CP-S
VB-03	62C 11 SOW 172C	364745076004303	nd	Virginia Beach	VBCH	Well	O	364746	760043	20	1/1/1981	35.0	20.0	18.0	20.0	30.0	1	Screen	Columbia	CP-S
VB-04	63C 11	364728075591401	nd	Virginia Beach	VBCH	Well	O	364728	755914	9	12/1/1980	85.0	70.0	68.0	70.0	80.0	1	Screen	Yorktown-Eastover	CP-S
VB-05	62C 32	365046076041601	nd	Virginia Beach	VBCH	Well	O	365046	760416	13	5/11/2000	168.0	138.0	134.0	138.0	148.0	1	Screen	Yorktown-Eastover	CP-S
VB-05b	62C 32	365046076041601	nd	Virginia Beach	VBCH	QA-Blank	nd	365046	760416	13	nd	nd	nd	nd	nd	nd	nd	nd	nd	QA
VB-06	62C 33	365046076041602	nd	Virginia Beach	VBCH	Well	O	365046	760416	13	5/12/2000	85.0	70.0	67.0	70.0	80.0	1	Screen	Columbia	CP-S
VB-07	61C 43	364558076074501	nd	Virginia Beach	VBCH	Well	O	364558	760745	6	5/8/2000	197.5	182.0	180.0	182.5	192.5	1	Screen	Yorktown-Eastover	CP-S
VB-08	61C 44	364558076074401	nd	Virginia Beach	VBCH	Well	O	364558	760744	6	5/9/2000	107.0	92.0	90.0	92.0	102.0	1	Screen	Yorktown-Eastover	CP-S
VB-09	62A 22	363714076063501	nd	Virginia Beach	VBCH	Well	O	363714	760635	10	5/4/2000	178.0	143.0	139.0	143.0	168.0	1	Screen	Yorktown-Eastover	CP-S
VB-10	62A 23	363714076063502	nd	Virginia Beach	VBCH	Well	O	363714	760635	10	5/5/2000	100.0	88.0	85.0	88.0	98.0	1	Screen	Yorktown-Eastover	CP-S
VB-11	62B 15	363812076021201	nd	Virginia Beach	VBCH	Well	O	363812	760212	14	5/1/2000	208.0	193.0	190.0	193.0	203.0	1	Screen	Yorktown-Eastover	CP-S
VB-12	62B 16	363812076021202	nd	Virginia Beach	VBCH	Well	O	363812	760212	14	5/2/2000	77.0	65.0	60.0	65.0	75.0	1	Screen	Yorktown-Eastover	CP-S
VB-13	61C 45	365212076091201	nd	Virginia Beach	VBCH	Well	O	365212	760912	20	5/16/2000	168.0	138.0	135.0	138.0	158.0	1	Screen	Yorktown-Eastover	CP-S
VB-14	61C 46	365212076091202	nd	Virginia Beach	VBCH	Well	O	365212	760912	20	5/16/2000	77.0	62.0	60.0	62.0	72.0	1	Screen	Yorktown-Eastover	CP-S
VB-14d	61C 46	365212076091202	nd	Virginia Beach	VBCH	QA-Dup	O	365212	760912	20	5/16/2000	77.0	62.0	60.0	62.0	72.0	1	Screen	Yorktown-Eastover	QA

Table 2. Site and well-construction information for wells and springs sampled in Virginia, 1998-2000—Continued

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VAS no.	USGS local no.	USGS site identifier	Public water supply no.	County/ City	Project[1]	Site type	Type of system[2]	Latitude	Longitude	Alt. (ft)	Date of construction	Well depth (ft-blsd)	Casing depth (ft-blsd)	Grout depth (ft-blsd)	Sample interval		Number of water zones	Water zone type	Aquifer type	Regional aquifer system[3]
															Top (ft-blsd)	Bottom (ft-blsd)				
VR-01	42S 2	383400078303901	VA2139935	Page	VAS	Well	C	383400	783039	1,175	8/16/1977	632.0	500.0	100.0	526.0	578.0	3	Fracture	Rome	VR-C
VR-02	42R 2	382920078361101	VA2139825	Page	VAS	Well	C	382920	783611	1,170	6/9/1994	500.0	nd	156.0	368.0	369.0	1	Fracture	Conococheague	VR-C
VR-03	39N 2	380311078541401	VA2820775	Waynesboro	VAS	Well	C	380312	785414	1,360	4/21/1977	432.0	432.0	100.0	191.0	400.0	3	Fracture	Rome	VR-C
VR-03d	39N 2	380311078541401	VA2820775	Waynesboro	VAS	QA-Dup	C	380312	785414	1,360	4/21/1977	432.0	432.0	100.0	191.0	400.0	3	Fracture	Rome	QA
VR-04	39NS 1	380311078555201	VA2820775	Augusta	VAS	Spring	C	380310	785554	1,320	nd	nd	nd	nd	nd	nd	nd	nd	Elbrook	VR-C
VR-05	35K 2	373800079264501	VA2163225	Rockbridge	VAS	Well	C	373800	792645	725	5/14/1964	317.0	172.0	120.0	172.0	317.0	1	Slotted	Shady	VR-C
VR-06	42R 3	382901078363101	VA2139825	Page	VAS	Well	C	382901	783631	1,080	7/7/1977	460.0	258.0	258.0	364.0	366.5	1	Fracture	Conococheague	VR-C
VR-07	42R 1	382843078363101	VA2139825	Page	VAS	Well	C	382843	783631	1,070	4/13/1983	660.0	395.0	395.0	648.0	649.0	1	Fracture	Conococheague	VR-C
VR-08	42S 3	383500078300501	VA2139935	Page	VAS	Well	C	383500	783005	1,050	5/19/1994	482.0	167.0	167.0	461.0	467.0	2	Fracture	Conococheague	VR-C
VR-09	43S 19	383602078291501	VA2139935	Page	VAS	Well	C	383602	782915	970	3/24/1983	300.0	169.0	50.0	203.0	300.0	1	Fracture	Conococheague	VR-C
VR-10	43S 17	383447078293201	VA2139935	Page	VAS	Well	C	383447	782941	1,070	8/13/1981	372.0	258.0	147.0	272.0	350.0	4	Fracture	Elbrook	VR-C
VR-11	42S 4	383403078303601	VA2139935	Page	VAS	Well	C	383403	783036	1,140	6/8/1962	490.0	316.0	100.0	333.0	490.0	7	Fracture	Rome	VR-S
VR-12	24G 1	371938080491301	VA1071565	Giles	VAS	Well	C	371938	804913	1,590	7/30/1953	270.0	172.0	nd	172.0	288.0	1	Slotted	Knox	VR-C
VR-13	25G 1	372017080410701	VA1071170	Giles	VAS	Well	C	372017	804107	1,835	3/1/1938	587.0	nd	nd	539.0	540.0	1	Fracture	Middle Ordovician	VR-C
VR-14	17BS 1	363748081423201	VA1191883	Washington	VAS	Spring	C	363748	814232	2,440	nd	nd	nd	nd	nd	nd	nd	nd	Shady	VR-C
VR-15	31M 1	375912079582501	VA2017103	Bath	VAS	Well	NC	375912	795825	1,650	7/28/1988	385.0	63.0	63.0	280.0	371.0	2	Fracture	Millboro	VR-S
VR-15bt	31M 1	375912079582501	nd	Bath	VAS	QA-Blank	nd	375912	795825	1,650	nd	nd	nd	nd	nd	nd	nd	nd	nd	QA
VR-16	40U 1	384854078455201	VA2171250	Shenandoah	VAS	Well	C	384853	784551	1,455	10/28/1970	385.0	75.0	nd	110.0	375.0	2	Fracture	Chemung	VR-S
VR-17	43V 3	385729078271401	VA2171800	Shenandoah	VAS	Well	C	385729	782714	785	nd	300.0	107.0	107.0	107.0	280.0	1	Open Hole	Conococheague	VR-C
VR-18	34R 1	382439079344801	VA2091150	Highland	VAS	Well	C	382426	793456	2,880	6/22/1978	360.0	100.0	100.0	340.0	341.0	1	Fracture	Millboro	VR-S
VR-19	35J 2	373715079290101	VA2163625	Rockbridge	VAS	Well	C	373715	792901	875	10/11/1972	610.0	575.0	140.0	610.0	610.0	1	Fracture	Elbrook	BR
VR-20	37M 4	375541079123501	VA2163675	Rockbridge	VAS	Well	C	375541	791235	1,730	9/8/1969	300.0	55.0	55.0	90.0	260.0	3	Fracture	Conococheague	VR-C
VR-21	33J 2	373034079420501	VA2023160	Botetourt	VAS	Well	C	373034	794205	1,010	2/6/1974	610.0	200.0	200.0	300.0	610.0	2	Fracture	Rome	VR-C
VR-22	30J 1	373101080050601	VA2045160	Craig	VAS	Well	C	373101	800506	1,230	1/1/1995	180.0	111.0	111.0	120.0	180.0	2	Fracture	Millboro	VR-S
VR-23	31G 2	371611079535201	VA2161830	Roanoke	VAS	Well	C	371611	795352	935	2/9/1987	625.0	50.0	50.0	320.0	335.0	1	Fracture	Granite	VR-S
VR-24	44Y 3	391920078190701	VA2069650	Frederick	VAS	Well	C	391920	781907	1,020	3/5/1992	810.0	104.0	100.0	600.0	700.0	2	Fracture	Chemung	VR-S
VR-25	44U 3	385135078182701	VA2187025	Warren	VAS	Well	NC	385135	781827	705	12/3/1997	700.0	115.0	103.0	639.0	685.0	2	Fracture	Martinsburg	VR-C
VR-26	36NS 2	380255079195601	VA2015150	Augusta	VAS	Spring	C	380255	791956	2,310	nd	nd	nd	nd	nd	nd	nd	nd	Devonian/Silurian	VR-S
VR-27	36N 1	380334079201801	VA2015150	Augusta	VAS	Well	C	380334	792018	1,670	6/28/1957	627.0	258.0	nd	258.0	627.0	1	Open Hole	Millboro	VR-S
VR-28	10D 24	365320082370101	VA1195376	Wise	VAS	Well	NC	365320	823701	3,530	4/27/1989	400.0	52.0	50.0	50.0	66.0	2	Fracture	Missipian Fms. Undiv	VR-S
VR-29	07C 3	364809082551601	VA1105075	Lee	VAS	Well	NC	364809	825516	1,640	2/21/1969	160.0	55.0	55.0	120.0	120.0	1	Fracture	Chattanooga	VR-S
VR-30	12B 1	364223082184101	VA1191310	Washington	VAS	Well	C	364223	821841	1,470	3/5/1990	620.0	129.0	125.0	129.0	620.0	1	Open Hole	Brallier	VR-S
VR-31	21F 1	371042081084901	VA1021400	Bland	VAS	Well	C	371042	810849	2,210	5/31/1989	652.0	211.0	211.0	211.0	652.0	1	Open Hole	Brallier	VR-S
VR-32	23D 2	365836080571701	VA1197345	Wythe	VAS	Well	C	365836	805717	2,080	7/6/1984	325.0	72.0	72.0	72.0	325.0	1	Open Hole	Rome	VR-S

Table 2. Site and well-construction information for wells and springs sampled in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; USGS, U.S. Geological Survey; Latitude and longitude in degrees, minutes, seconds in NAD27 datum; Alt., altitude of land surface, datum is sea level NGVD29; ft, feet; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	USGS local no.	USGS site identifier	Public water supply no.	County/ City	Project[1]	Site type	Type of system[2]	Latitude	Longitude	Alt. (ft)	Date of construction	Well depth (ft-blsd)	Casing depth (ft-blsd)	Grout depth (ft-blsd)	Sample interval Top (ft-blsd)	Sample interval Bottom (ft-blsd)	Number of water zones	Water zone type	Aquifer type	Regional aquifer system[3]
VR-33	31M 3	375531079585301	VA2023135	Botetourt	VAS	Well	NC	375531	795853	1,600	10/4/1977	265.0	112.0	130.0	185.0	227.0	2	Fracture	Brallier	VR-S
VR-34	33L 1	374719079421201	VA2005490	Alleghany	VAS	Well	NC	374719	794212	1,275	7/12/1982	255.0	105.0	nd	105.0	255.0	1	Open Hole	Millboro/Needmore	VR-S
VR-35	21E 1	370039081104801	VA1197743	Wythe	VAS	Well	NC	370039	811048	2,450	7/27/1971	130.0	61.0	60.0	88.0	186.0	3	Fracture	Huntersville	VR-S
VR-35b	21E 1	370039081104801	nd	Wythe	VAS	QA-Blank	nd	370039	811048	2,450	nd	nd	nd	nd	nd	nd	nd	nd	nd	QA
VR-36	24G 3	372217080480501	VA1071920	Giles	VAS	Well	C	372217	804805	2,120	1/1/1995	602.0	177.0	177.0	502.0	510.0	1	Fracture	Moccasin/Bays	VR-S
VR-37	17D 1	365527081434301	VA1173785	Smyth	VAS	Well	C	365527	814343	2,030	6/2/1988	404.0	52.0	nd	80.0	404.0	4	Fracture	Brallier	VR-S
VR-37d	17D 1	365527081434301	VA1173785	Smyth	VAS	QA-Dup	C	365527	814343	2,030	6/2/1988	404.0	52.0	nd	80.0	404.0	4	Fracture	Brallier	QA
VR-38	24D 1	365433080485601	VA1197120	Wythe	VAS	Well	C	365433	804856	2,200	8/12/1980	510.0	129.0	129.0	490.0	510.0	1	Fracture	Shady	VR-C
VR-39	27E 2	370328080263101	VA1121655	Montgomery	VAS	Well	C	370328	802631	2,020	11/16/1979	720.0	115.0	nd	245.0	700.0	3	Fracture	Rome	VR-S
VR-40	27F 3	371214080291601	VA1121580	Montgomery	VAS	Well	C	371214	802916	2,010	11/7/1971	180.0	114.0	nd	135.0	175.0	1	Fracture	Rome	VR-S
VR-41	27F 4	371158080291201	VA1121580	Montgomery	VAS	Well	C	371158	802912	1,990	2/25/1982	350.0	110.5	nd	245.0	247.0	1	Screen	Elbrook	VR-C
VR-42	26G 2	372123080321901	VA1071551	Giles	VAS	Well	NTNC	372123	803219	3,930	11/18/1987	605.0	51.0	51.0	62.0	118.0	3	Fracture	Reedsville/ Eggleston/Moccasin	VR-S
VR-42bt	26G 2	372123080321901	nd	Giles	VAS	QA-Blank	nd	372123	803219	3,930	nd	nd	nd	nd	nd	nd	nd	nd	nd	QA
VR-43	26H 1	372234080311901	VA1071550	Giles	VAS	Well	NC	372234	803119	3,845	9/22/1992	140.0	130.0	63.0	130.0	140.0	1	Open Hole	Rose Hill	VR-S
VR-44	26G 1	372119080321101	VA1071551	Giles	VAS	Well	NTNC	372119	803211	3,910	10/1/1968	198.0	120.0	nd	120.0	198.0	1	Open Hole	Reedsville/ Eggleston/Moccasin	VR-C
VR-45	38N 5	380022079025601	VA2015575	Augusta	VAS	Well	C	380022	790256	1,425	9/22/1994	505.0	290.0	105.0	290.0	505.0	3	Fracture	Waynesboro	VR-C
VR-46	37P 8	381242079134701	VA2015120	Augusta	VAS	Well	C	381242	791347	1,715	9/30/1994	540.0	187.0	147.5	192.0	192.0	1	Fracture	Devonian/Silurian	VR-S
VR-47	39N 15	380311078541501	VA2820775	Waynesboro	VAS	Well	C	380311	785415	1,360	1/10/1997	735.0	380.0	119.0	380.0	735.0	1	Open Hole	Waynesboro	VR-S
VTDW-01	29E 1	370249080120801	nd	Floyd	VPI	Well	D	370249	801208	2,800	nd	200.0	nd	nd	nd	nd	nd	nd	Augen gneiss	BR
VTDW-03A	29E 4	370245080120901	nd	Floyd	VPI	Well	O	370245	801209	2,730	nd	178.0	nd	nd	135.0	178.0	nd	nd	Augen gneiss	BR
VTDW-03B	29E 4	370245080120901	nd	Floyd	VPI	Well	O	370245	801209	2,730	nd	178.0	nd	nd	0.0	135.0	nd	nd	Augen gneiss	BR
VTDW-07A	29E 7	370246080120601	nd	Floyd	VPI	Well	O	370246	801206	2,740	nd	300.0	nd	nd	120.0	300.0	nd	nd	Augen gneiss	BR
VTDW-07B	29E 7	370246080120601	nd	Floyd	VPI	Well	O	370246	801206	2,740	nd	300.0	nd	nd	0.0	120.0	nd	nd	Augen gneiss	BR
VTDW-08	29E 2	370246080120602	nd	Floyd	VPI	Well	O	370246	801206	2,740	nd	57.0	nd	nd	52.0	57.0	1	Screen	Augen gneiss	BR

[1] Project designation: VAS, Virginia Aquifer Susceptibility study; VBCH, Virginia Beach shallow ground water study; VPI, Virginia Polytechnic and State Unversity fractured rock hydrology study

[2] Type of system designation: C, community; D, domestic; I, irrigation; NC, transient non-community; NTNC, non-transient non-community; O, observation

[3] VAS Aquifer System designation: AP, Appalachian Plateaus; BR, Blue Ridge; CP-D, Coastal Plain Deep system (depths greater than 400 ft); CP-M, Coastal Plain Middle system (depths between 200 and 400 ft); CP-S, Coastal Plain Shallow system (depths less than 200 ft); PD, Piedmont; VR-C, Valley and Ridge Carbonates; VR-S, Valley and Ridge Siliciclastics; QA, Quality assurance sample

mined using the NAVSTAR Global Positioning System (GPS) Precise Positioning Service (PPS) equipment. These geographic coordinates were calculated by averages of position fixes for every second over a 15-minute interval (900 readings). The altitude of the well or spring was determined by plotting the GPS position on the USGS Digital Raster Quadrangles (DRQs) of the 7.5-minute topographic quadrangles. Well-construction information was compiled from files of the USGS, VDH, Virginia Department of Environmental Quality, Virginia Division of Mineral Resources, and individual well owners.

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SAMPLE COLLECTION, ANALYTICAL METHODS, AND QUALITY ASSURANCE

In most cases, existing pumps and plumbing were used to collect the water samples from the public supply wells. Samples were collected from a point as close to the wellhead as possible and prior to any storage tank or filtration device. Typical connections to the sample tap for a public water supply are shown on figure 3. Water samples from springs were collected with a stainless-steel piston displacement pump (Bennett pump) by placing the pump in the reservoir constructed over the spring. The samples collected as part of the Virginia Beach study were collected from 4-in.-inside-diameter polyvinyl chloride (PVC) wells using the Bennett pump. Water samples from wells at the VPI&SU fractured-rock hydrology research site were collected with the Bennett pump, except for VTDW-01, which is a domestic supply well equipped with a standard submersible pump and water system. Samples from wells VTDW-03A and VTDW-07A were collected with the Bennett pump after specific intervals were isolated with inflatable packers.

Sample collection and analytical methods were designed to eliminate contact of the sample water with the atmosphere. The path from the wellhead and from the pump for springs to the sample containers was closed from contact with the air. A minimum of three well volumes was removed during purging, and field properties were stabilized (table 3) before samples were collected. Sample collection and analytical methods are presented in the following sections.

Water Chemistry

Collection and preservation of water samples followed procedures and guidelines established by the USGS. Water samples for cation analysis were filtered through a 0.45µm (micron) filter, collected in an acid-rinsed 250-mL polyethylene bottle, and acidified with 2 mL of nitric acid. Water samples for anion analysis were collected in a 250-mL polyethylene bottle. Major, minor, and trace-element water chemistry was determined at the USGS National Research Program Common Use Laboratory in Reston, Va., by the methods listed in table 4. Detection limits and measurement precisions are also in table 4. Water samples for nitrite plus nitrate (NO_2+NO_3) analysis were collected in a

Figure 3. Connections to sample tap on discharge line *(A)* and at the wellhead *(B)*.

Table 3. Measurement accuracy and stability criteria for water-quality field properties during purging (From Nelms and others, 2001)

[±, plus or minus; min, minute; µS/cm, microsiemens per centimeter at 25 degrees Celsius; <, less than; °C, degrees Celsius; mg/L, milligrams per liter]

Water-quality field property	Measurement accuracy[1]	Stability criteria[2]
pH	± 0.01 units	0.1 units/min
Specific conductance	± 2.5 µS/cm	0.5 (µS/cm)/min for <500 µS/cm
	± 5.0 µS/cm	1.0 (µS/cm)/min for 500-1000 µS/cm
Temperature	± 0.1°C	0.02°C/min
Dissolved Oxygen	± 0.3 mg/L	0.03 (mg/L)/min

[1]From Beckman Instruments, Inc. (1992) and Yellow Springs Instruments, Inc. (1996)
[2]From Gibs and Imbrigiotta (1990)

Table 4. Detection limits, measurement precisions, and analytical methods for water samples analyzed for water chemistry at the USGS National Research Program Common Use Laboratory in Reston, Virginia

[mg/L, milligrams per liter; µg/L, micrograms per liter; DCP, multi-element direct-current plasma spectrometer; ICP-MS, inductively coupled plasma-mass spectrometer; IC, ion chromatograph]

Water-quality parameter	Detection limit	Measurement precision[1] (percent)	Analytical method
Calcium (Ca)	0.1 mg/L	3 to 5	DCP
Magnesium (Mg)	0.01 mg/L	3 to 5	DCP
Strontium (Sr)	0.005 mg/L	3 to 5	DCP
Silica (SiO_2)	0.1 mg/L	5	DCP
Sodium (Na)	0.05 mg/L	3 to 5	DCP
Potassium (K)	0.1 mg/L	5 to 10	DCP
Iron (Fe)	0.01 mg/L	5 to 10	DCP
Manganese (Mn)	0.005 mg/L	5	DCP
Aluminum (Al)	0.005 mg/L	10 to 15	DCP
Copper (Cu)	0.1 µg/L	3 to 5	ICP-MS
Nickel (Ni)	0.1 µg/L	3 to 5	ICP-MS
Rubidium (Rb)	0.1 µg/L	3 to 5	ICP-MS
Vanadium (V)	0.1 µg/L	3 to 5	ICP-MS
Barium (Ba)	1 µg/L	3 to 5	ICP-MS
Lithium (Li)	1 µg/L	3 to 5	ICP-MS
Zinc (Zn)	1 µg/L	3 to 5	ICP-MS
Lead (Pb)	0.05 µg/L	3 to 5	ICP-MS
Boron (B)	20 µg/L	3 to 5	ICP-MS
Fluoride (F)	0.05 mg/L	3	IC
Chloride (Cl)	1 mg/L	3	IC
Sulfate (SO_4)	2 mg/L	3 to 5	IC
Bromide (Br)	0.005 to 0.02 mg/L	10	IC

[1] From Plummer and others (2000).

125-mL brown polyethylene bottle after the water passed through a 0.45µm filter. NO_2+NO_3 concentrations were determined by the automated-segmented flow, colorimetric procedure (Fishman, 1993) at the USGS National Water Quality Laboratory (NWQL) in Denver, Colo. Water samples for dissolved organic carbon (DOC) analysis were collected in a 125-mL amber glass bottle after the water passed through a 0.45µm-silver filter that had been conditioned with 50 mL of organic-free volatile organic compounds-grade water. DOC concentrations were determined by the uv-promoted persulfate oxidation and infrared spectrometric procedure (Brenton and Arnett, 1993) at the USGS NWQL in Denver, Colo. Water samples for ^{222}Rn analysis were collected from a flow chamber (fig. 4) by use of the syringe method described by Cecil and Yang (1987) and were shipped to the laboratory daily via overnight mail. ^{222}Rn activities were determined by liquid scintillation counting at the USGS NWQL in Denver, Colo.

Major Dissolved and Noble Gases

Water samples for major dissolved and noble gases analysis were collected by filling a 160-mL glass serum bottle through a discharge line from the pump. Contact of the water sample with the atmosphere was minimized by the following procedure: the 160-mL bottle was submerged in a 7.5-L container filled with water from the well or spring (fig. 5). The sample was then sealed in the 160-ml bottle by placing a rubber stopper with a hypodermic needle inserted. The needle was removed from the stopper while the bottle was submerged to prevent gas exchange between the sample and atmosphere (M.W. Doughten, USGS, written commun., 1997). Three sequential duplicate samples were collected at each well and spring. Dissolved gas concentrations of N_2, Ar, O_2, CO_2, and CH_4 were measured by gas chromatography procedures (see *http://water.usgs.gov/lab/cfc*) at the USGS Dissolved Gas Laboratory in Reston, Va. Busenberg and others (1998) report that concentrations of N_2 and Ar are within 1 percent for replicate analyses of laboratory standards. Analytical uncertainties for dissolved O_2, CO_2, and CH_4 analyses are similar, but microbial processes in the sample bottle can cause uncertainties of as much as 20 percent. Dissolved noble gas concentrations of He and Ne were measured by gas chromatography procedure with a thermal conductivity detector, which is similar to the procedure described by Sugisaki and others (1982), in the USGS CFC Laboratory in Reston, Va. The precisions of the gas-chromatographic results are 10 and 20 percent for He and Ne, respectively (E. Busenberg, USGS, written commun., 2001).

Chlorofluorocarbons

Water samples for CFC analysis were collected through a 0.25-in-diameter copper tubing connected either to the sample tap at the wellhead or the Bennett pump. The samples were flame-sealed in 62-mL borosilicate-glass ampoules by means of a special apparatus (fig. 6) developed by Busenberg and Plummer (1992). This apparatus prevents the water sample from contacting the atmosphere, which could cause error in the estimates of ground-water apparent age if air from the time of sampling is introduced. Six sequential duplicate samples were collected from each site. The samples were analyzed by purge-and-trap gas chromatography with an electron-capture detector (Busenberg and Plummer, 1992; see *http://water.usgs.gov/lab/cfc*) at the USGS CFC Laboratory in Reston, Va. Concentrations were measured for the following CFC compounds: trichlorofluoromethane (CCl_3F, CFC-11, Freon 11), dichlorodifluoromethane (CCl_2F_2, CFC-12, Freon 12), and trichlorotrifluoroethane ($C_2Cl_3F_3$, CFC-113). The detection limit for CFC-11 and CFC-12 was near 0.3 pg/kg (picogram per kilogram) and for CFC-113 was approximately 1.0 pg/kg (Plummer and others, 1998).

Sulfur Hexafluoride

Water samples for SF_6 analysis were collected in a 2.5-L plastic-coated bottle. To eliminate contact of the water sample with the atmosphere, the tube from the sample tap at the wellhead or the Bennett pump was placed in the bottom of the bottle and at least three bottle volumes were allowed to overflow before the sample was captured. The bottles were sealed without headspace by screw caps with conical liners. Two to four sequential duplicate samples were collected from each site. The samples were analyzed by purge-and-trap gas chromatographic procedures (Busenberg and Plummer, 2000; see *http://water.usgs.gov/lab/cfc*) at the USGS CFC Labo-

Figure 4. Flow chamber used to collect radon-222 sample.

Figure 5. Collection of dissolved gas samples.

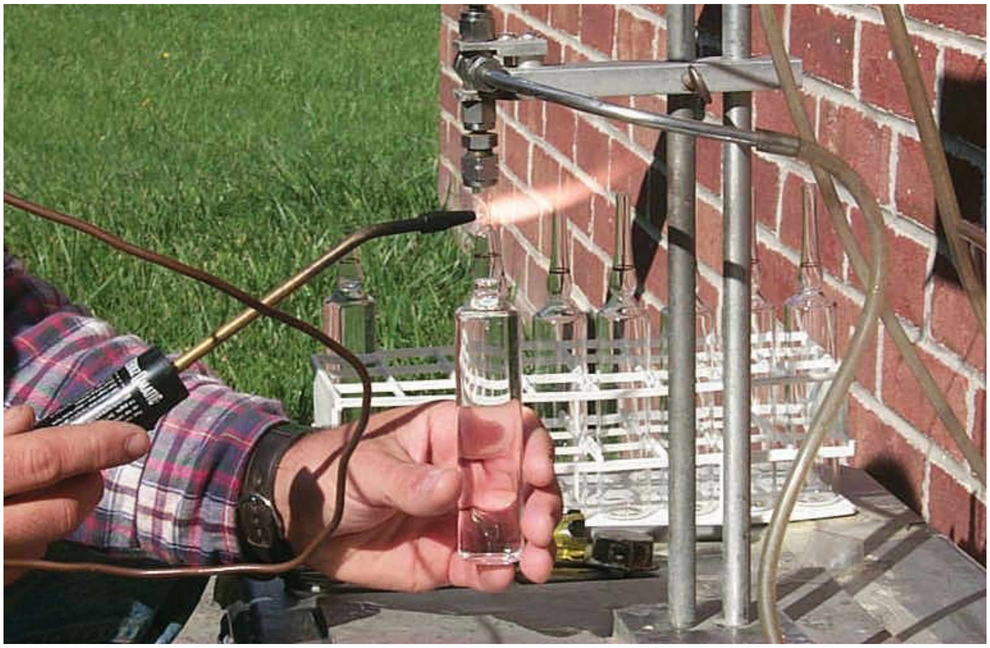

Figure 6. Collection of chlorofluorocarbon age-dating samples.

ratory in Reston, Va. The detection limit for SF_6 was approximately 1.5 fg/L (femtograms per liter).

Tritium

Water samples for ^{3}H analysis were collected in a 500-mL plastic-coated bottle that was capped with a polycone seal. A small headspace was left in the bottle to prevent bottle breakage that could result from expansion of the water upon warming. The samples were enriched electrolytically and analyzed by liquid scintillation counting following procedures modified from Thatcher and others (1977) at the USGS Low-Level ^{3}H Laboratory in Menlo Park, Calif. Precision estimates (2σ or 2 standard deviations) for the ^{3}H results by liquid scintillation counting were between 0.3 and 1 TU (tritium unit). Water samples for ^{3}H analysis as part of the ^{3}H/^{3}He dating technique were analyzed by the ^{3}He ingrowth technique (Clarke and others, 1976; Bayer and others, 1989) at the Noble Gas Laboratory at Lamont-Doherty Earth Observatory of Columbia University, Palisades, N.Y. The 2σ precision estimates for the ^{3}H results by the ^{3}He ingrowth technique were between 0.1 and 0.5 TU.

Tritium/Helium-3 and Noble Gases

Water samples for ^{3}H/^{3}He age determination (^{3}H, δ^3He, ^{4}He, and Ne) were collected by attaching the tube from the sample tap at the wellhead or the Bennett pump to 80-cm-long copper tubes fitted with stainless steel pinch-off clamps (fig. 7). The discharge ends of the copper tubes were fitted with an overpressure valve to prevent gas bubbles from forming in the water samples. The samples in the copper tubes were analyzed by mass-spectrometric procedures outlined in Ekwurzel and others (1994) and Ludin and others (1998) at the Noble Gas Laboratory at Lamont-Doherty Earth Observatory of Columbia University, Palisades, N.Y. The term δ^3He is expressed as percent and is the deviation of the helium isotopic ratio (^{3}He/^{4}He) of the water sample from that of air, which is $1.384\text{x}10^{-6}$ (Clarke and others, 1976):

$$\delta^3\text{He} = \left(\frac{\left(\frac{^3\text{He}}{^4\text{He}}\right)_{sample}}{\left(\frac{^3\text{He}}{^4\text{He}}\right)_{air}} - 1\right)100. \qquad (1)$$

Figure 7. Collection of tritium/helium-3 age-dating samples.

Plummer and others (2000) provide a detailed explanation of the analytical extraction and separation process and calculation of analytical errors for the $^{3}H/^{3}He$ age determinations.

Isotope Ratios of Carbon in Water

Water samples for the determination of carbon-13 ($\delta^{13}C$) and carbon-14 (^{14}C) activity of dissolved inorganic carbon (DIC) were collected in either 250-mL or 1,000-mL plastic-coated glass bottles fitted with a Teflon septum. Sample volume was dependent upon the pH and alkalinity of the water (fig. 8). Samples were filtered (0.45µ) to eliminate possible contamination from particulates containing carbonate minerals; contact with the atmosphere was minimized by establishing a closed path from the sample tap. Samples for the determination of $\delta^{13}C$ of DIC in water were analyzed by mass spectrometric analysis at the Environmental Isotope Laboratory of the Department of Earth Sciences at University of Waterloo, Waterloo, Ontario, Canada. The isotope ratio $\delta^{13}C$ of DIC is expressed as the per mil (parts per thousand) deviation from the Vienna Peedee belemnite (VPDB) standard (Coplen, 1994):

$$ {}^{13}C = \left(\frac{\left(\frac{{}^{13}C}{{}^{12}C}\right)_{sample}}{\left(\frac{{}^{13}C}{{}^{12}C}\right)_{VPDB}} - 1 \right) 1,000. \qquad (2) $$

The 1σ precision estimates for the $\delta^{13}C$ results were 0.1 ‰ (per mil). Samples for the determination of ^{14}C activity of DIC in water were analyzed by accelerator mass spectrometry (AMS) at the Rafter Radiocarbon Laboratory, Institute of Geological and Nuclear Sciences Ltd., Lower Hutt, New Zealand. The 1σ precision estimates for the ^{14}C activity of DIC in water ranged from 0.1 to 0.8 pmc (percent modern carbon).

Stable Isotope Ratios of Oxygen and Hydrogen in Water

Water samples for the determination of the stable isotope ratios of oxygen ($\delta^{18}O$) and hydrogen ($\delta^{2}H$) were collected in 60-mL glass bottles with polycone-seal liner caps. The samples were analyzed

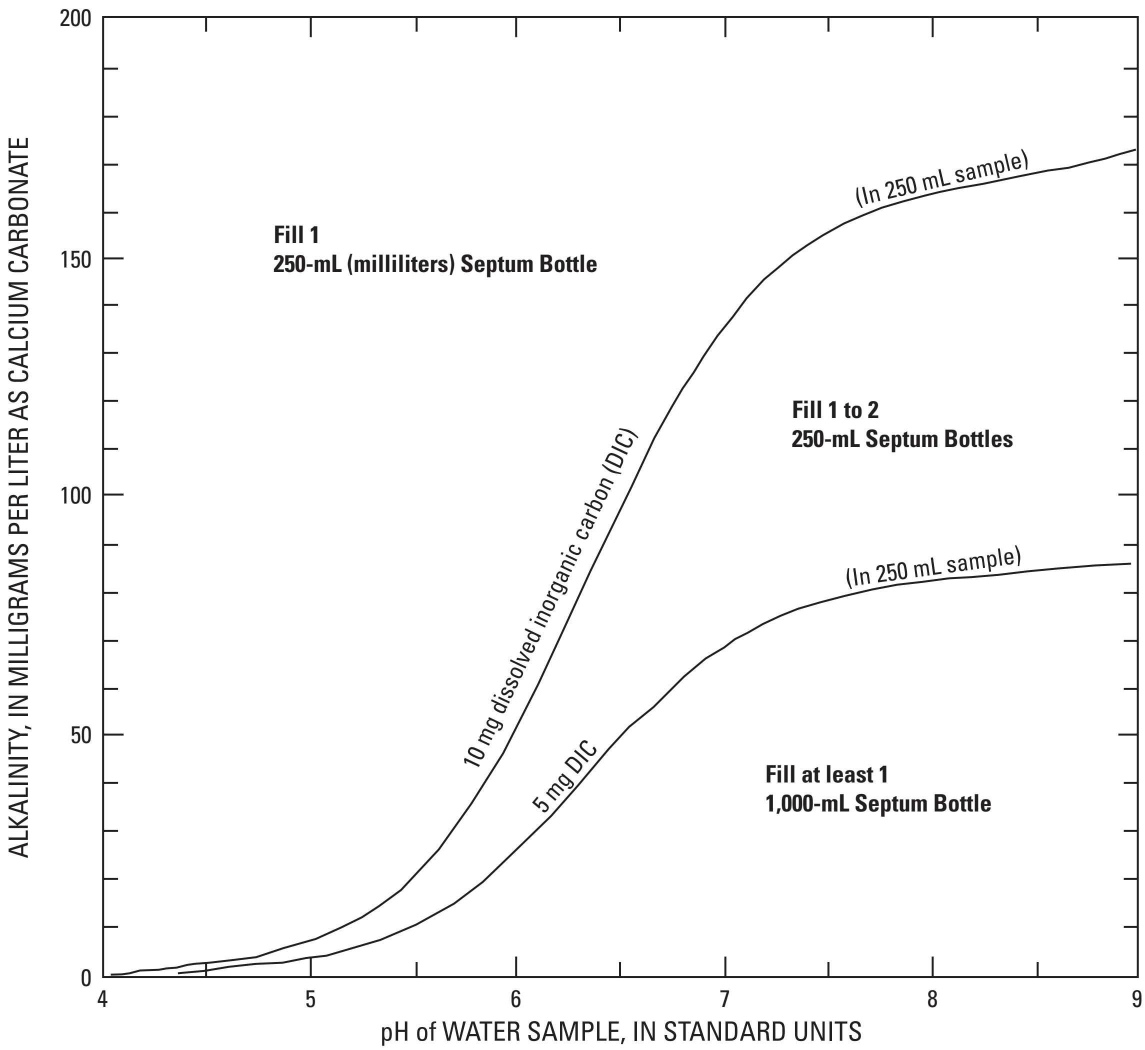

Figure 8. Sample volume requirements for carbon isotope analysis by accelerator mass spectrometry (AMS).

for $\delta^{18}O$ by the carbon dioxide-equilibration technique of Epstein and Mayeda (1953) and for $\delta^{2}H$ by the hydrogen equilibration technique of Coplen and others (1991) at the USGS Stable Isotope Laboratory in Reston, Va. The stable isotope ratios are expressed as the per mil deviation from the VSMOW (Vienna Standard Mean Ocean Water) standard (Coplen, 1996):

$$\delta^{13}O = \left(\frac{\left(\frac{^{18}O}{^{16}O}\right)_{sample}}{\left(\frac{^{18}O}{^{16}O}\right)_{VSMOW}} - 1 \right) 1,000, \tag{3}$$

and

$$\delta^{2}H = \left(\frac{\left(\frac{^{2}He}{^{1}He}\right)_{sample}}{\left(\frac{^{2}He}{^{1}He}\right)_{VSMOW}} - 1 \right) 1,000. \tag{4}$$

The values for the stable isotope ratios were normalized (Coplen, 1988) on scales such that the $\delta^{18}O$ and $\delta^{2}H$ values of SLAP (Standard Light Antarctic Precipi-

tation) are -55.5 and -428 ‰, respectively. The 2σ precision estimates of $\delta^{18}O$ and $\delta^{2}H$ results were 0.2 and 1.5 ‰, respectively.

Quality Assurance

Quality assurance (QA) samples (duplicate and blank samples) were collected for 15 water samples (10 percent of the 151 water samples). The duplicate samples were collected five minutes after the original water sample to quality assure the sample collection and analytical methodology for data on water chemistry (major, minor, and trace elements), dissolved major and noble gases, tritium, helium, carbon, and stable isotopes. QA procedures are included in the methodology for the CFCs and SF_6 data, in that a representative water sample consists of multiple (two to six) duplicate samples. The blank samples were collected by passing de-ionized organic-free reagent-grade water through the sample equipment; these samples were only analyzed for water chemistry. The dissolved gases, environmental tracer, and isotopic data preclude the use of blank samples as a means of QA.

ANALYTICAL AND QUALITY ASSURANCE DATA

Analytical and quality assurance data for water samples collected between 1998 and 2000 are in (tables 5-19). The following sections summarize the contents of each of these tables. Apparent ground-water ages based on CFCs, SF_6, and $^3H/^3He$ are defined as the time elapsed since the water sample was isolated from the unsaturated-zone air. As stated earlier, the apparent ages in the following tables are age estimates from the tracers, not the final ages assigned for the water samples.

Water Chemistry

Water-quality field properties (water temperature, dissolved oxygen, pH, and specific conductance) and major element composition–dissolved species of calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), chloride (Cl), sulfate (SO_4), and bicarbonate from titration alkalinity (HCO_3) of the water samples are summarized in table 5. Minor-element composition–dissolved species of strontium (Sr), silica (SiO_2), iron (Fe), manganese (Mn), and fluoride (F) of the water samples and concentrations of nitrate (NO_2+NO_3), DOC, and ^{222}Rn are summarized in table 6. Trace-element composition–dissolved species of aluminum (Al), boron (B), barium (Ba), bromide (Br), lithium (Li), zinc (Zn), lead (Pb), copper (Cu), nickel (Ni), rubidium (Rb), and vanadium (V) of the water samples is summarized in table 7.

Major Dissolved and Noble Gases, Recharge Temperature, and Excess Air

Selected and/or averaged dissolved gas concentrations of N_2, Ar, O_2, CO_2, CH_4, He, and Ne are summarized in table 8. Concentrations of dissolved N_2, Ar, and Ne were used to estimate recharge temperatures and quantities of excess air (Herzberg and Mazor, 1979; Heaton, 1981; Heaton and Vogel, 1981; Heaton and others, 1983; Busenberg and others, 1993; Stute and Schlosser, 1999) and to assess potential for gas-exchange. The N_2-Ar recharge temperature is defined as the temperature at the water table during recharge (Plummer and others, 2000). This assumes that the dissolved concentrations of N_2 and Ar were in solubility equilibrium during recharge. Excess air is defined as air in the unsaturated zone that is in excess of solubility equilibrium (Plummer and Busenberg, 2000). As the water table rises, excess air is entrained in ground water and is eventually dissolved by increasing hydrostatic pressures with depth. Ground-water dating techniques based on CFCs, SF_6, and $^3H/^3He$ can be affected by uncertainties in estimates of recharge temperature and excess air, and by gas-exchange processes.

Selected and/or averaged values of recharge temperature and excess air based on the dissolved N_2 and Ar concentrations are summarized in table 8; the number of analyses used to calculate the averaged values is indicated in the n_{dg} column. In some cases, a local mean annual air temperature was assumed to be the recharge temperature and excess air was assumed to be zero because values of recharge temperature and excess air could not be determined from the N_2 and Ar data (in these cases, the recharge temperature and excess air values are italicized). Negative values of excess air based on the dissolved N_2 and Ar concentrations are in

table 8; these negative estimates can be caused by uncertainty in recharge elevation (land surface), analytical error, and/or sample degassing (Plummer and others, 2000).

The dissolved concentrations of He and Ne as measured by the gas chromatography procedure are summarized in table 8. The dissolved concentrations of He were used to screen for large excesses of terrigenic He in the samples collected for $^3H/^3He$ dating. Large excesses of terrigenic He can complicate the $^3H/^3He$ dating technique or even prevent the application of this dating technique. Values of excess air were estimated from dissolved Ne concentrations as measured by the mass-spectrometric procedures, if available, and are summarized in table 8.

Chlorofluorocarbon Concentrations and Apparent Ages

Averaged concentrations of the CFCs (CFC-11, CFC-12, and CFC-13) in pg/kg are summarized in table 9. The averaged concentrations were typically calculated from the measured concentrations in 3 of the 6 sequential duplicate samples collected at each site. Partial pressures of CFCs that were in equilibrium with the measured concentrations in the water samples are summarized in table 9. Plummer and Busenberg (2000) state that CFC partial pressures are expressed as dry air mixing ratios at sea level and for age-dating purposes are comparable to concentrations of CFCs in North American air (see table 10). The N_2-Ar recharge temperatures and recharge elevations used to calculate the CFC partial pressures are also summarized in table 9.

Apparent recharge dates and ages estimated from the averaged partial pressures of CFC-11, CFC-12, and CFC-113 are summarized in table 11. The apparent recharge dates are based on (1) concentrations of CFCs in the North American air in table 10, and (2) the concept of piston or plug flow, which assumes that the tracer (the CFC compound) is transported as a plug through the aquifer with no dispersive mixing in the direction of flow (Busenberg and Plummer, 1992). Uncertainties in apparent ages are summarized in table 11 and are based on an uncertainty of ± 1.0ºC in the respective N_2-Ar recharge temperature (Plummer and others, 2000).

Sulfur Hexafluoride Concentrations and Apparent Ages

Selected and/or averaged SF_6 concentrations and calculated partial pressures in the water samples based on the technique described in Busenberg and Plummer (2000) are summarized in table 12. The modeled SF_6 partial pressures are summarized in table 12 and corrected for introduction of SF_6 from excess air in the sample. Busenberg and Plummer (2000) describe the iterative procedure that removes SF_6 introduced by excess air in the sample. The apparent recharge dates and ages are based on a comparison of the values of the modeled SF_6 partial pressures with the concentrations of SF_6 in North American air in table 10. Various uncertainties in apparent ages are summarized in table 12 and are based on (1) 1σ precision estimate of the measured concentrations, (2) an uncertainty of ± 1.0ºC in the respective N_2-Ar recharge temperature, and (3) an uncertainty of ± 1.0 cc/L in the excess air values from the respective N_2 and Ar data.

Tritium, Helium, and Neon Data, and Apparent Tritium/Helium-3 Ages

Tritium and dissolved noble gas (He and Ne) data used to calculate apparent ages with the $^3H/^3He$ dating method are summarized in table 13. The ^3H data are reported in TU with 2σ precision estimates in TU. Concentrations of He and Ne are reported in ccSTP/g (cubic centimeters at standard temperature and pressure per gram). The excess concentrations of He and Ne (Δ^4He and ΔNe) greater than the solubility equilibrium concentrations based on recharge temperature and elevation are reported as percentages in table 13. Terrigenic He is expressed as a percentage of the total He in the water sample. Plummer and others (2000) define percent terrigenic He as the excess of He after subtraction of He from air-water equilibrium during recharge and from excess air. Small percentages indicate that a majority of the dissolved He is from solubility equilibrium during recharge and from excess air (Plummer and others, 2000). Large percentages indicate that a majority of the dissolved He has a terrigenic origin.

The apparent $^3H/^3He$ ages and corresponding age uncertainties are summarized in table 14. The apparent ages are presented as uncorrected and corrected ages. The calculation of uncorrected age is based on the

assumption that the dissolved He was derived from solubility equilibrium, excess air and the decay of ^{3}H. A correction for terrigenic He sources is not included in the calculation of uncorrected age. If a sample contains enough terrigenic He to cause a difference between uncorrected and corrected ages of more than approximately 0.5 year, the terrigenic He is subtracted from the analyses and the corrected age is calculated from the corrected He concentration (Plummer and others, 2000). The presence or absence of terrigenic He in sufficient quantities for each sample is indicated in the Terrigenic He column in table 14 as "Y" (yes)" or "N" (no), respectively. If terrigenic He is present in sufficient quantities ("Y"), then the corrected age is reported as the final apparent $^{3}H/^{3}He$ age. The uncorrected age is reported as the final apparent $^{3}H/^{3}He$ age for samples in which terrigenic He is not present or not present in sufficient quantities ("N"). Schlosser and others (1988, 1989), Poreda and others (1988), Solomon and Sudicky (1991), Solomon and others (1993), Ekwurzel and others (1994), and Solomon and Cook (1999) provide a more detailed explanation of the $^{3}H/^{3}He$ dating method.

Carbon Isotope Data and Adjusted Radiocarbon Ages

Carbon isotopic data of DIC in water samples from wells in the Coastal Plain province of Virginia are summarized in table 15. Values of $\delta^{13}C$ of DIC are reported in per mil relative to the VPDB (Coplen, 1994). The ^{14}C isotopic ratios of DIC and 1σ precision estimates for the water samples are summarized in table 15 and are consistent with the recommendations of Stuiver and Polach (1977). The values of $\Delta^{14}C$ and $\delta^{14}C$ of DIC represent the per mil depletion or enrichment of ^{14}C of DIC relative to the former NBS I oxalic acid standard and are corrected for decay since 1950. The values of $\Delta^{14}C$ of DIC are normalized for isotopic fractionation of ^{13}C, whereas the values of $\delta^{14}C$ of DIC are not (Stuiver and Polach, 1977). The values for ^{14}C activities in table 15 are in pM (Absolute percent Modern carbon) and pmc (percent modern carbon), consistent with the recommendations of Stuiver and Polach (1977) where pM is relative to the former NBS-I oxalic acid standard, normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950. The pmc unit is relative to the same standard and corrected for decay since 1950, but is not normalized for isotopic fractionation of ^{13}C. Radiocarbon dating of DIC in ground water uses ^{14}C activities in pmc because isotopic variations in $\delta^{13}C$ of DIC are caused by geochemical reactions in ground-water systems and are not affected by in vitro fractionation processes as in organic matter.

Radiocarbon ages of DIC in water samples from wells in the Coastal Plain province of Virginia are summarized in table 16. The conventional radiocarbon ages of DIC in the water samples in table 16 were calculated with the following assumptions from Stuiver and Polach (1977):

1. the Libby half-life of 5,568 years for ^{14}C,
2. atmospheric levels of ^{14}C have remained constant,
3. the former NBS I oxalic acid standard,
4. ^{14}C activities are normalized for ^{13}C isotopic fractionation to the base of $\delta^{13}C$ = -25‰ relative to VPDB, and
5. base year of 1950, with ages in radiocarbon years BP (where present is AD 1950).

Adjusted radiocarbon ages for the water samples from wells in the Coastal Plain province of Virginia are summarized in table 16. Application of adjustment models to the individual water samples accounts for inorganic reactions that could have affected the inorganic carbon reservoir in the aquifers sampled (Plummer and others, 1994). Inorganic carbon adjustment models determine an adjusted ^{14}C activity in the observed water with the assumption that radioactive decay of ^{14}C had not occurred. The radiocarbon age of the water is determined by comparing the adjusted ^{14}C activity to the measured ^{14}C activity through the radioactive decay equation (Plummer and others, 1994). The adjusted radiocarbon ages are summarized in table 16 and were determined by the inorganic carbon adjustment models of Fontes and Garnier (1979), Tamers (1975), Ingerson and Pearson (1964), Mook (1972), and Eichinger (1983). These adjustment models were accessed through the geochemical model NETPATH (Plummer and others, 1994). The following initial conditions were assumed for each adjustment model:

1. ^{14}C activity in carbonate minerals of 0 pmc,

2. ^{14}C activity in soil gas CO_2 of 100 pmc,

3. $\delta^{13}C$ in carbonate minerals of 0 ‰ relative to VPDB, and

4. $\delta^{13}C$ in soil gas CO_2 of -20 ‰ relative to VPDB.

The adjusted radiocarbon ages are based on the Libby half-life of 5,568 years and are in radiocarbon years BP (present is AD 1950). The radiocarbon ages have not been calibrated to calendar years. The initial or adjusted ^{14}C activities as determined by the respective adjustment models are also summarized in table 16.

Stable Isotope Ratios of Oxygen and Hydrogen in Water

Analyses of the stable isotope ratios of oxygen ($\delta^{18}O$) and hydrogen ($\delta^{2}H$) in water are summarized in table 17 and are expressed as the per mil deviation from the VSMOW standard (Coplen, 1996). Values for deuterium excess (*d*) also are summarized in table 17. Clark and Fritz (1997) defines the term *d* as:

$$d = \delta^{2} - 8\delta^{18}O \quad (5)$$

Quality Assurance

The QA evaluation procedures were dependent upon the type of QA water sample. The duplicate water samples were evaluated using the Relative Percent Difference (RPD), which is defined as (U.S. Environmental Protection Agency, 1994):

$$\mathrm{RPD} = \frac{|S - D|}{(S + D)/2} \mathrm{x} 100 \quad (6)$$

where S and D are the constituent concentrations for the original and duplicate water samples, respectively. RPD values for each constituent are summarized in table 18. Approximately 75 percent of the maximum values for RPD are less than 25-percent difference. The large maximum RPD values generally are associated with concentrations slightly greater than the USGS minimum reporting limits, and these differences are considered insignificant.

The blank QA samples were evaluated by reviewing the analytical results in terms of the detection of water chemistry constituents. Summary statistics for the blank QA samples are shown in table 19. Generally, the concentrations reported are below or slightly greater than the USGS reporting limits. The relatively low concentrations detected in the blank QA samples are considered insignificant.

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TABLES 5-19

Table 5. Summary of water-quality field properties and major-element chemistry[1] in water samples from wells and springs in Virginia, 1998-2000

[VAS, Virginia Aquifer Susceptibility study; Temp., field water temperature; ºC, degrees Celsius; O_2, dissolved oxygen; mg/L, milligrams per liter; Sp. Cond., specific conductance at 25ºC; µS/cm, microsiemens per centimeter; Q, discharge; gal/min, gallons per minute; ft, feet below NGVD29; Ca, calcium; Mg, magnesium, Na, sodium; K, potassium; Cl, chloride; SO_4, sulfate; HCO_3, total titration alkalinity as bicarbonate; nd, not determined; <, actual value is known to be less than value shown; E, estimated concentration; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Temp. (ºC)	O_2 (mg/L)	pH	Sp Cond (µS/cm)	Q (gal/min)	Pump setting (ft)	Pump type	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Cl (mg/L)	SO_4 (mg/L)	HCO_3 field (mg/L)	HCO_3 lab (mg/L)
AP-01	7/10/2000	1045	15.1	nd	7.4	337	15	nd	Submersible	16.8	4.76	51.3	1.8	15.4	2.5	185	181
AP-02	7/1020/00	1400	14.4	nd	6.7	394	6	nd	Submersible	32.7	7.73	25.8	1.6	39.8	42.7	115	99
AP-03	7/20/2000	1045	14.3	3.0	7.2	576	16	845	Submersible	67.8	14.62	30.4	1.1	9.1	42.6	289	296
AP-03d	7/20/2000	1050	14.3	3.0	7.2	576	16	845	Submersible	68.1	14.66	30.7	1.2	9.2	42.7	289	297
AP-04	7/11/2000	1050	13.8	0.4	7.1	637	32	nd	Submersible	49.4	11.62	69.0	2.3	66.9	28.0	241	245
AP-05	7/12/2000	0950	12.9	0.6	6.7	355	51	nd	Submersible	23.7	6.67	44.5	2.3	9.7	10.2	194	196
AP-06	7/13/2000	0905	13.1	0.4	6.9	526	650	nd	Turbine	35.4	10.87	52.2	2.3	18.5	58.7	193	197
AP-07	7/13/2000	1445	12.4	0.7	6.8	266	11.5	nd	Submersible	31.2	7.72	19.3	2.2	1.2	<0.5	184	184
AP-08	7/10/2000	0950	12.8	3.4	7.7	380	60	273	Submersible	41.2	11.54	25.6	0.6	9.7	28.9	195	198
AP-09	7/10/2000	1345	14.5	1.2	7.1	945	20	215	Submersible	27.0	11.10	214.0	3.2	5.3	35.6	681	672
AP-10	7/11/2000	1115	13.8	1.2	7.0	340	20	296	Submersible	37.4	10.57	52.1	1.3	7.6	34.9	252	248
AP-11	7/11/2000	1530	13.6	3.8	7.2	454	36	168	Submersible	36.0	8.44	82.9	2.8	5.3	10.4	373	362
AP-12	7/12/2000	1140	14.3	3.1	7.9	183	15	nd	Submersible	11.1	2.28	41.2	1.3	2.3	<0.1	150	150
AP-13	7/12/2000	1430	14.7	0.6	7.1	235	3.75	nd	Submersible	28.9	7.77	10.0	1.7	8.3	11.6	136	136
BR-01	7/19/1999	1100	15.6	0.5	7.1	320	72	nd	Submersible	38.2	5.52	19.2	1.1	23.2	19.5	131	134
BR-02	7/19/1999	1500	17.0	8.7	5.8	75	15	319	Submersible	5.8	1.32	6.5	2.1	11.1	4.0	21	21
BR-03	7/20/1999	0910	11.1	9.6	6.0	64	45	nd	Submersible	6.2	2.91	2.0	0.4	7.6	<0.2	24	27
BR-04	7/20/1999	1425	14.5	0.7	6.4	147	252	nd	Submersible	17.9	4.12	3.0	3.1	1.5	19.0	69	65
BR-05	8/25/1999	1115	14.2	7.8	7.4	257	170	60	Turbine	28.9	16.43	1.2	3.0	1.9	1.3	164	171
BR-06	9/13/1999	1715	13.6	4.3	6.6	643	17	252	Submersible	72.7	15.00	26.1	9.2	103.6	32.3	170	170
BR-07	9/14/1999	0940	14.8	0.3	6.9	376	85	nd	Submersible	48.2	8.04	11.3	6.5	24.7	34.2	149	149
BR-08	9/16/1999	0940	13.8	6.7	5.6	228	28	nd	Submersible	17.8	10.16	7.9	1.7	30.2	7.3	56	56
BR-09	10/18/1999	1720	15.4	0.6	6.1	350	2	nd	Submersible	43.0	16.20	9.9	8.6	11.7	149.1	105	97
BR-10	10/26/1999	0947	13.4	1.3	6.2	446	nd	nd	Submersible	48.4	15.90	12.8	8.2	44.9	34.4	164	160
CP-01	6/23/1998	1338	21.6	0.7	7.3	238	109	357	Submersible	0.2	0.10	53.0	2.8	0.9	16.4	107	130
CP-01d	6/23/1998	1342	21.6	0.7	7.3	238	109	357	Submersible	0.2	0.10	53.5	2.7	0.9	16.4	107	129
CP-02	6/24/1998	1142	19.1	0.2	8.3	323	174	250	Submersible	8.5	2.82	57.6	9.5	3.1	5.9	154	196
CP-03	6/25/1998	1231	22.7	0.1	7.5	351	82	295	Submersible	0.2	0.11	78.5	3.2	1.2	10.6	171	203

Table 5. Summary of water-quality field properties and major-element chemistry[1] in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Temp., field water temperature; ºC, degrees Celsius; O_2, dissolved oxygen; mg/L, milligrams per liter; Sp. Cond., specific conductance at 25ºC; µS/cm, microsiemens per centimeter; Q, discharge; gal/min, gallons per minute; ft, feet below NGVD29; Ca, calcium; Mg, magnesium, Na, sodium; K, potassium; Cl, chloride; SO_4, sulfate; HCO_3, total titration alkalinity as bicarbonate; nd, not determined; <, actual value is known to be less than value shown; E, estimated concentration; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Temp. (ºC)	O_2 (mg/L)	pH	Sp Cond (µS/cm)	Q (gal/min)	Pump setting (ft)	Pump type	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Cl (mg/L)	SO_4 (mg/L)	HCO_3 field (mg/L)	HCO_3 lab (mg/L)
CP-04	7/1/1998	1024	21.6	0.2	8.1	338	190	210	Submersible	1.0	0.23	76.9	5.3	1.2	13.7	169	204
CP-05	7/6/1998	1213	24.8	0.1	8.4	498	15	nd	Submersible	4.4	1.85	103.2	10.3	1.9	3.5	317	324
CP-06	7/6/1998	1434	28.8	0.1	8.3	764	90	230	Submersible	1.0	0.28	174.1	6.4	6.4	17.1	444	474
CP-07	7/7/1998	1158	23.9	0.3	7.9	305	104	252	Submersible	16.4	6.13	39.3	12.6	1.3	1.2	178	194
CP-08	7/7/1998	1459	18.7	0.1	8.3	511	28	140	Submersible	6.6	3.12	101.7	12.1	1.9	1.0	327	338
CP-09	7/8/1998	1159	16.4	0.1	7.1	1,560	20	nd	Submersible	145.1	17.45	140.1	11.1	335.9	40.1	267	278
CP-10	7/8/1998	1505	19.4	0.2	8.2	694	30	nd	Submersible	10.3	4.25	100.4	12.4	2.3	6.6	238	341
CP-11	7/9/1998	1121	16.1	0.1	7.4	397	9.3	nd	Submersible	54.9	7.17	15.4	5.6	17.8	3.2	210	220
CP-11b	7/9/1998	1126	16.1	0.1	7.4	397	9.3	nd	nd	<0.1	<0.05	<0.1	<0.1	<0.2	<0.2	nd	<1
CP-12	7/14/1998	1327	17.2	0.2	8.0	204	100	126	Submersible	29.2	1.08	9.2	0.9	15.7	1.6	93	96
CP-13	7/15/1998	0920	15.7	0.1	7.8	694	280	140	Turbine	34.8	24.60	55.4	23.5	99.6	3.7	217	235
CP-14	7/15/1998	1220	15.4	5.5	5.6	141	68	42	Submersible	7.2	4.90	8.2	1.9	7.8	25.7	18	19
CP-15	7/15/1998	1410	15.9	0.2	7.8	1,070	nd	160	Turbine	46.7	30.40	103.7	25.6	197.5	13.9	243	254
CP-16	7/16/1998	1008	16.2	0.1	7.7	270	100	134	Submersible	29.6	6.15	14.3	6.3	9.8	<0.2	143	152
CP-17	7/16/1998	1351	16.4	0.1	7.6	337	230	nd	Turbine	36.4	8.39	16.7	9.2	15.6	<0.2	177	185
CP-18	7/27/1998	1117	16.8	0.8	7.5	368	250	150	Turbine	57.6	8.12	4.6	9.6	2.6	4.6	220	229
CP-19	7/27/1998	1545	18.0	0.1	7.1	358	118	190	Submersible	49.0	11.66	6.3	3.9	2.1	13.3	204	214
CP-20	7/28/1998	1102	21.0	0.1	8.0	816	140	nd	Submersible	1.1	0.49	192.2	8.6	17.3	7.8	476	491
CP-21	7/29/1998	1059	17.2	0.1	6.8	352	50	30	Turbine	45.6	3.98	17.4	2.0	22.3	11.1	142	159
CP-22	7/30/1998	1048	17.3	0.1	7.3	335	98	216	Submersible	5.5	3.75	59.8	8.6	5.1	9.5	187	194
CP-23	8/3/1998	1126	18.0	0.2	7.9	245	10.4	nd	Submersible	22.0	3.86	20.4	10.0	1.2	5.4	150	146
CP-23d	8/3/1998	1131	18.0	0.2	7.9	245	10.4	nd	Submersible	22.1	3.90	20.4	10.0	1.3	5.6	150	146
CP-24	8/4/1998	0936	18.9	0.1	8.1	852	178	168	Submersible	2.3	0.70	181.4	10.1	65.2	10.0	393	410
CP-25	8/4/1998	1440	16.8	0.2	8.2	372	50	189	Submersible	6.5	1.72	69.9	9.0	3.1	5.8	218	229
CP-26	8/5/1998	1325	16.4	6.9	4.8	181	100	42	Turbine	7.3	7.34	10.1	1.8	13.6	22.3	2	2
CP-27	8/6/1998	1001	21.9	0.1	7.8	2,330	83	289	Submersible	5.9	1.91	510.0	15.7	369.0	59.0	670	720
CP-28	8/17/1998	1015	16.1	0.1	7.3	544	90	320	Submersible	42.1	13.88	38.9	6.7	33.7	88.1	154	156
CP-29	8/17/1998	1340	16.5	0.1	7.8	339	63	nd	Submersible	0.5	0.30	67.8	4.1	10.5	49.8	117	119

Table 5. Summary of water-quality field properties and major-element chemistry[1] in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Temp., field water temperature; ºC, degrees Celsius; O_2, dissolved oxygen; mg/L, milligrams per liter; Sp. Cond., specific conductance at 25ºC; µS/cm, microsiemens per centimeter; Q, discharge; gal/min, gallons per minute; ft, feet below NGVD29; Ca, calcium; Mg, magnesium, Na, sodium; K, potassium; Cl, chloride; SO_4, sulfate; HCO_3, total titration alkalinity as bicarbonate; nd, not determined; <, actual value is known to be less than value shown; E, estimated concentration; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Temp. (ºC)	O_2 (mg/L)	pH	Sp Cond (µS/cm)	Q (gal/min)	Pump setting (ft)	Pump type	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Cl (mg/L)	SO_4 (mg/L)	HCO_3 field (mg/L)	HCO_3 lab (mg/L)
CP-30	8/18/1998	1000	16.5	0.3	7.7	235	85	nd	Submersible	0.6	0.34	50.7	5.0	0.6	16.7	118	124
CP-31	8/19/1998	1620	15.7	0.1	7.7	242	nd	320	Submersible	0.4	0.21	50.3	3.0	1.0	26.1	100	113
CP-32	8/31/1998	1053	17.6	0.1	8.3	388	nd	nd	Submersible	0.3	0.09	90.7	2.9	2.0	4.2	239	248
CP-33	8/31/1998	1453	15.7	0.2	6.8	229	40	150	Submersible	30.0	5.06	7.4	4.2	3.4	6.3	138	130
CP-34	8/31/1998	1731	15.8	0.1	5.5	96	nd	68	Submersible	5.2	1.52	4.4	4.1	9.3	17.2	8	4
CP-34d	8/31/1998	1736	15.8	0.1	5.5	96	nd	68	Submersible	5.3	1.52	4.2	4.0	9.3	17.2	8	5
CP-35	9/1/1998	1038	17.4	0.3	7.8	811	134	249	Submersible	1.0	0.58	158.6	6.6	161.7	9.9	153	165
CP-36	9/1/1998	1545	16.5	0.2	8.1	391	80	nd	Submersible	2.4	0.64	87.0	7.2	2.9	8.7	227	238
CP-37	9/2/1998	0950	17.9	0.2	7.4	286	222	320	Submersible	12.2	6.39	23.6	26.5	2.0	15.6	138	151
CP-38	9/2/1998	1259	17.9	0.2	7.5	259	330	nd	Submersible	8.3	2.94	31.2	20.9	1.4	13.9	145	139
CP-39	9/2/1998	1548	16.7	0.2	7.4	345	20	nd	Submersible	35.3	10.00	17.5	8.6	14.2	11.5	163	179
CP-40	9/3/1998	0919	18.8	0.2	7.8	323	nd	nd	Submersible	2.6	0.38	67.1	4.6	1.3	13.6	145	189
CP-41	9/10/1998	1115	18.1	0.1	7.8	405	24	nd	Submersible	0.6	0.35	91.4	4.8	1.6	9.3	228	244
CP-42	9/10/1998	1440	20.8	0.1	8.3	602	50	nd	Submersible	0.9	0.41	138.5	6.3	2.2	16.7	361	377
CP-43	10/1/1998	1135	16.9	0.2	8.7	501	52	nd	Submersible	2.6	0.70	117.1	9.0	2.6	4.0	283	321
CP-44	10/5/1998	1110	17.4	0.3	8.1	912	60	42	Submersible	2.4	1.93	192.5	12.5	83.1	20.8	339	402
CP-45	10/5/1998	1505	15.7	0.2	7.5	292	90	nd	Submersible	41.8	3.24	7.2	1.0	7.9	26.7	116	129
CP-46	10/6/1998	1020	17.4	6.4	5.1	36	nd	nd	Submersible	1.1	0.47	2.4	2.7	2.2	0.7	2	5
CP-47	10/6/1998	1430	18.2	0.3	8.0	382	185	170	Submersible	3.2	0.24	87.3	3.6	2.4	1.9	239	251
CP-48	10/7/1998	1027	17.2	7.1	4.6	70	4	nd	Submersible	0.5	1.19	6.3	2.5	6.7	<0.2	2	3
CP-49	10/27/1998	1025	16.9	0.3	7.4	343	4.5	nd	Submersible	63.2	1.52	5.5	1.2	4.8	7.5	182	199
CP-50	10/28/1998	1205	16.0	3.9	4.4	66	nd	nd	Gravity	1.1	2.12	4.2	1.7	8.2	0.9	nd	2
CP-51	11/4/1998	1220	24.9	0.2	7.4	6,230	1,112	227	Turbine	39.9	10.50	1,260.0	24.5	1,860.0	102.1	317	132
CP-51d	11/4/1998	1225	24.9	0.2	7.4	6,230	1,112	nd	Turbine	40.7	10.70	1,270.0	24.8	1,870.0	102.8	317	132
PD-01	6/28/1999	1435	19.3	0.3	6.7	184	80	210	Submersible	14.9	3.20	17.7	4.4	2.4	6.8	94	98
PD-02	6/29/1999	1530	15.4	0.3	6.4	141	nd	230	Submersible	14.3	4.88	6.3	4.3	2.0	9.0	79	78
PD-03	6/30/1999	1030	16.1	1.8	6.8	196	320	300	Submersible	25.3	5.84	6.2	1.5	8.3	8.6	100	103
PD-04	6/30/1999	1500	15.8	0.8	7.4	173	51	336	Submersible	20.2	5.86	6.1	2.3	2.4	8.1	97	98

Table 5. Summary of water-quality field properties and major-element chemistry[1] in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Temp., field water temperature; ºC, degrees Celsius; O_2, dissolved oxygen; mg/L, milligrams per liter; Sp. Cond., specific conductance at 25ºC; µS/cm, microsiemens per centimeter; Q, discharge; gal/min, gallons per minute; ft, feet below NGVD29; Ca, calcium; Mg, magnesium, Na, sodium; K, potassium; Cl, chloride; SO_4, sulfate; HCO_3, total titration alkalinity as bicarbonate; nd, not determined; <, actual value is known to be less than value shown; E, estimated concentration; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Temp. (ºC)	O_2 (mg/L)	pH	Sp Cond (µS/cm)	Q (gal/min)	Pump setting (ft)	Pump type	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Cl (mg/L)	SO_4 (mg/L)	HCO_3 field (mg/L)	HCO_3 lab (mg/L)
PD-05	7/1/1999	1240	14.4	0.3	6.2	160	45	nd	Submersible	18.0	3.49	5.9	2.2	6.7	13.5	74	69
PD-06	8/23/1999	1245	14.7	4.2	7.0	192	108	nd	Submersible	27.8	6.63	4.0	1.0	2.6	22.1	100	99
PD-07	8/23/1999	1515	15.2	2.5	6.2	112	76	294	Submersible	5.8	5.35	4.4	0.6	4.3	18.3	50	44
PD-08	8/30/1999	1100	15.6	7.8	6.4	245	12	200	Submersible	30.0	6.55	12.8	1.3	8.9	23.4	98	114
PD-09	8/31/1999	1045	15.6	1.5	7.4	544	105	nd	Submersible	62.4	19.00	26.4	8.2	38.0	17.1	278	286
PD-10	9/1/1999	1045	14.7	7.3	5.2	109	nd	10	Bennett	6.2	3.34	6.3	2.3	15.1	1.9	18	17
PD-11	9/1/1999	1350	15.6	5.6	5.8	127	20	180	Submersible	11.8	3.09	7.0	2.0	8.4	2.6	41	47
PD-12	9/1/1999	1720	16.5	0.5	6.7	905	32	126	Submersible	63.6	22.40	82.0	6.6	125.7	141.1	145	146
PD-13	9/2/1999	1030	13.7	8.0	5.7	55	nd	1.5	Bennett	4.9	2.28	2.2	0.6	2.2	0.4	28	28
PD-14	9/2/1999	1230	14.6	7.0	5.8	67	26	180	Submersible	6.4	2.34	3.0	0.8	2.6	0.8	30	34
PD-15	9/2/1999	1545	15.4	0.6	6.3	128	28	nd	Submersible	9.9	2.93	5.5	4.6	7.1	5.3	57	52
PD-15d	9/2/1999	1550	15.4	0.6	6.3	128	28	nd	Submersible	10.0	2.93	5.6	4.7	7.1	5.3	57	52
PD-16	9/13/1999	1035	15.0	0.8	7.2	1,307	171	189	Submersible	196.0	27.30	66.1	2.0	30.6	491.1	212	212
PD-17	9/13/1999	1448	15.8	0.3	7.5	669	73	nd	Submersible	86.0	19.80	26.9	0.6	15.9	202.2	142	143
PD-18	10/18/1999	1030	17.3	1.1	7.1	390	100	200	Submersible	53.4	11.00	12.8	2.9	12.0	16.4	216	217
PD-19	10/19/1999	1130	14.8	3.9	7.7	246	49	nd	Submersible	38.2	6.70	3.1	0.5	5.7	5.9	144	143
PD-20	10/19/1999	1545	14.6	0.9	6.2	206	120	nd	Submersible	17.4	9.49	7.8	1.5	6.7	6.8	116	109
PD-20b	10/20/1999	0800	nd	nd	nd	nd	nd	nd	nd	0.2	<0.1	1.1	0.4	<0.1	<0.1	nd	4
PD-21	10/25/1999	0920	15.9	1.7	7.2	172	18	nd	Submersible	12.8	6.93	11.1	4.1	1.8	7.5	102	102
PD-22	10/25/1999	1240	14.9	6.3	5.7	69	16	nd	Submersible	5.3	3.21	3.3	1.3	1.5	1.5	42	40
PD-23	10/25/1999	1722	16.0	3.5	7.2	904	288	350	Turbine	116.6	27.20	45.6	1.3	25.1	278.5	263	256
PD-24	10/26/1999	1324	13.4	8.0	6.8	493	390	144	Turbine	69.5	15.50	8.9	3.2	27.1	11.0	260	250
PD-25	6/27/2000	1035	14.8	5.5	6.7	201	6	189	Submersible	12.7	13.27	6.5	3.4	3.9	3.1	110	120
PD-26	6/27/2000	1500	15.5	5.0	7.0	246	30	nd	Submersible	35.4	5.72	5.7	2.0	5.7	5.0	140	141
PD-27	6/28/2000	0920	16.4	1.6	7.8	454	56	270	Submersible	27.4	0.45	78.5	0.1	30.2	22.7	210	215
PD-28	6/28/2000	1440	16.6	1.5	7.3	203	60	294	Submersible	27.7	4.19	7.1	1.9	6.6	10.2	106	106
PD-29	6/29/2000	1130	15.9	0.8	7.2	255	144	140	Submersible	34.4	4.50	8.6	3.4	12.0	18.1	132	115
PD-30	6/29/2000	1540	16.0	0.6	6.1	153	4	nd	Submersible	13.4	3.86	9.4	1.5	2.2	27.6	53	50

Table 5. Summary of water-quality field properties and major-element chemistry[1] in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Temp., field water temperature; ºC, degrees Celsius; O_2, dissolved oxygen; mg/L, milligrams per liter; Sp. Cond., specific conductance at 25ºC; µS/cm, microsiemens per centimeter; Q, discharge; gal/min, gallons per minute; ft, feet below NGVD29; Ca, calcium; Mg, magnesium, Na, sodium; K, potassium; Cl, chloride; SO_4, sulfate; HCO_3, total titration alkalinity as bicarbonate; nd, not determined; <, actual value is known to be less than value shown; E, estimated concentration; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Temp. (ºC)	O_2 (mg/L)	pH	Sp Cond (µS/cm)	Q (gal/min)	Pump setting (ft)	Pump type	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Cl (mg/L)	SO_4 (mg/L)	HCO_3 field (mg/L)	HCO_3 lab (mg/L)
VB-01	5/13/1999	1615	15.8	0.2	7.6	339	4.8	100	Grundfos-2	29.7	11.90	16.5	9.7	17.5	<0.1	163	nd
VB-02	5/14/1999	1115	15.7	0.2	6.8	192	2.4	50	Grundfos-2	25.5	5.71	9.5	1.2	12.4	1.6	106	nd
VB-03	5/10/1999	1830	16.4	0.3	6.8	256	3.8	20	Grundfos-2	25.3	4.27	14.4	1.3	13.5	9.1	82	nd
VB-04	5/12/1999	1230	15.3	0.3	7.5	256	3.2	66.5	Grundfos-2	30.3	3.41	10.7	1.6	12.3	0.2	94	nd
VB-05	8/14/2000	1415	17.1	0.4	7.8	1,643	4.7	143	Grundfos-2	25.8	40.50	209.0	30.9	348.0	0.6	376	370
VB-05b	8/14/2000	1410	nd	nd	nd	nd	nd	nd	nd	0.2	0.03	<0.1	<0.2	<0.3	<0.3	nd	1
VB-06	8/11/2000	1000	17.4	0.4	6.9	593	5	75	Grundfos-2	54.9	16.50	32.1	7.7	37.2	E0.2	318	301
VB-07	8/10/2000	1110	16.6	0.5	7.1	11,492	1.2	180	Grundfos-2	81.5	146.00	2,150.0	6.3	3,380.0	210.0	950	950
VB-08	8/9/2000	1130	16.2	0.1	7.2	2,832	4.5	97	Grundfos-2	35.5	39.10	459.0	31.9	677.0	2.8	492	482
VB-09	8/16/2000	1520	16.0	0.0	7.6	3,037	3.7	150	Grundfos-2	41.4	59.80	456.0	29.4	701.0	56.6	466	470
VB-10	8/17/2000	1045	15.7	0.2	7.4	576	2	93	Grundfos-2	52.9	23.00	17.2	15.9	35.7	1.0	306	306
VB-11	8/16/2000	0945	16.6	0.2	7.6	10,011	2	190	Grundfos-2	41.6	90.40	1,910.0	45.3	3,080.0	80.2	680	676
VB-12	8/15/2000	1115	16.3	0.2	7.6	307	5	70	Grundfos-2	46.2	2.57	10.3	1.4	9.7	2.2	179	174
VB-13	8/8/2000	1225	16.4	0.1	7.5	524	5	148	Grundfos-2	61.3	6.05	36.0	2.7	54.8	1.5	237	232
VB-14	8/72/2000	1745	16.4	0.1	7.8	359	5	65	Grundfos-2	52.5	6.04	12.2	3.0	13.9	<0.3	216	212
VB-14d	8/72/2000	1750	16.4	0.1	7.8	359	5	65	Grundfos-2	52.8	6.02	12.4	3.0	13.9	<0.3	216	212
VR-01	7/6/1999	1230	15.3	7.7	7.8	241	25	494	Submersible	26.5	14.82	0.8	1.7	0.9	0.5	158	160
VR-02	7/6/1999	1615	13.4	7.4	7.5	343	150	nd	Submersible	42.4	17.47	1.3	2.6	2.0	2.0	216	220
VR-03	7/7/1999	1035	13.2	6.9	7.8	132	800	104.5	Turbine	14.6	7.47	1.3	1.3	2.1	3.4	77	77
VR-03d	7/7/1999	1040	13.2	6.9	7.8	132	800	104.5	Turbine	14.7	7.42	1.2	1.2	2.1	3.4	77	77
VR-04	7/7/1999	1400	12.7	7.4	7.7	186	nd	10	Bennett	21.8	10.44	1.2	1.8	1.7	10.3	103	105
VR-05	7/8/1999	1015	15.0	2.8	7.4	301	640	nd	Turbine	44.0	11.13	3.9	1.6	7.3	9.5	177	178
VR-06	7/8/1999	1620	12.0	7.3	7.3	302	95	376	Turbine	48.5	10.57	1.0	2.2	1.7	2.0	205	207
VR-07	7/8/1999	1820	12.3	6.3	7.4	294	128	nd	Submersible	39.7	15.89	0.9	2.3	1.5	2.4	200	203
VR-08	7/9/1999	1015	15.4	5.7	7.5	285	400	250	Submersible	37.4	11.08	4.8	3.0	7.4	8.8	162	163
VR-09	7/9/1999	1300	14.1	7.0	7.8	249	32	nd	Submersible	33.9	8.57	3.8	2.7	6.6	6.1	134	137
VR-10	7/9/1999	1500	13.7	6.1	7.6	313	100	336	Submersible	41.0	11.24	5.9	2.4	11.9	8.4	164	165
VR-11	7/9/1999	1645	12.9	7.4	7.7	235	25	295	Submersible	29.5	12.60	0.8	2.4	0.9	0.6	144	158

Table 5. Summary of water-quality field properties and major-element chemistry[1] in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Temp., field water temperature; ºC, degrees Celsius; O_2, dissolved oxygen; mg/L, milligrams per liter; Sp. Cond., specific conductance at 25ºC; µS/cm, microsiemens per centimeter; Q, discharge; gal/min, gallons per minute; ft, feet below NGVD29; Ca, calcium; Mg, magnesium, Na, sodium; K, potassium; Cl, chloride; SO_4, sulfate; HCO_3, total titration alkalinity as bicarbonate; nd, not determined; <, actual value is known to be less than value shown; E, estimated concentration; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Temp. (ºC)	O_2 (mg/L)	pH	Sp Cond (µS/cm)	Q (gal/min)	Pump setting (ft)	Pump type	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Cl (mg/L)	SO_4 (mg/L)	HCO_3 field (mg/L)	HCO_3 lab (mg/L)
VR-12	7/21/1999	0945	13.9	7.8	7.5	346	194	150	Submersible	38.5	22.97	1.5	1.4	3.8	4.0	215	219
VR-13	7/21/1999	1250	13.6	9.1	7.1	497	33	399	Submersible	87.7	8.30	5.9	0.6	16.4	10.7	267	272
VR-14	7/22/1999	1200	12.8	9.1	8.4	98	585	4	Bennett	10.8	5.76	0.4	1.7	0.6	2.4	62	63
VR-15	8/10/1999	1400	14.1	0.8	8.2	366	30	nd	Submersible	6.7	4.19	77.2	0.1	4.4	27.7	215	215
VR-15bt	8/10/1999	1405	nd	nd	nd	nd	nd	nd	nd	0.3	<0.1	<0.1	<0.1	<0.2	<0.2	nd	<1.0
VR-16	8/11/1999	1330	12.8	1.1	7.0	269	28	374	Submersible	29.9	10.20	18.8	0.4	5.4	24.8	158	156
VR-17	8/11/1999	1630	13.1	4.5	6.8	531	48	nd	Submersible	88.9	17.10	6.2	1.8	18.2	14.1	324	330
VR-18	8/12/1999	1130	12.8	0.7	7.3	334	76	nd	Submersible	39.5	15.90	11.5	1.3	19.1	29.2	163	166
VR-19	8/24/1999	1050	13.2	4.2	7.5	254	118	356	Submersible	29.2	16.30	1.8	1.4	4.7	3.4	159	162
VR-20	8/24/1999	1315	13.3	6.5	7.0	482	42	210	Submersible	78.5	18.18	1.5	1.2	4.9	4.7	302	310
VR-21	8/25/1999	1530	13.2	3.3	7.4	371	92	540	Submersible	37.6	25.44	0.9	1.8	1.8	18.5	224	227
VR-22	8/26/1999	0925	14.1	6.1	6.9	216	375	111	Submersible	39.7	2.31	1.7	0.9	3.0	5.6	114	126
VR-23	8/26/1999	1400	17.5	0.4	7.5	972	328	200	Submersible	154.5	27.10	16.3	3.7	12.2	410.6	111	110
VR-24	10/27/1999	0925	13.2	0.7	7.7	266	76	nd	Submersible	28.2	9.60	18.1	0.4	2.9	8.7	162	165
VR-25	10/27/1999	1340	14.5	2.2	8.7	405	60	nd	Submersible	21.4	5.94	70.8	1.2	1.7	29.6	238	236
VR-26	10/28/1999	1010	10.9	9.6	7.4	163	nd	1.5	Bennett	32.1	2.23	0.5	0.7	0.8	3.0	103	104
VR-27	10/28/1999	1345	12.3	8.5	7.7	255	38	240	Submersible	30.7	4.78	1.1	0.7	1.0	4.4	113	115
VR-28	7/12/00	1415	12.2	0.3	7.2	150	5	390	Submersible	17.7	3.25	5.5	1.7	0.7	10.7	76	75
VR-29	7/13/2000	1108	13.4	0.9	6.4	114	18	151	Submersible	7.9	4.04	8.0	1.1	0.9	5.4	75	66
VR-30	7/13/2000	1415	18.2	1.5	7.3	209	50	nd	Submersible	11.3	2.69	29.4	2.6	7.5	5.0	109	111
VR-31	7/17/2000	0950	15.2	0.3	7.8	397	10	nd	Submersible	29.7	6.76	46.8	0.9	16.4	16.1	208	204
VR-32	7/17/2000	1321	13.1	1.3	7.1	549	233	131	Submersible	56.9	37.85	1.0	1.6	1.4	13.2	360	358
VR-33	7/18/2000	1030	11.4	7.3	7.4	352	9	190	Submersible	63.9	3.62	1.7	1.2	1.3	26.9	190	188
VR-34	7/18/2000	1400	12.7	5.3	8.4	223	10	230	Submersible	4.7	1.83	45.0	0.3	0.9	3.6	149	143
VR-35	7/19/2000	0915	13.7	0.5	6.8	207	nd	nd	Submersible	25.4	4.70	3.2	1.3	0.5	26.7	94	84
VR-35b	7/19/2000	1000	nd	nd	nd	nd	nd	nd	nd	<0.1	-0.00	<0.05	<0.1	<0.1	<0.2	nd	<1
VR-36	7/20/2000	1430	13.3	6.0	7.3	423	28	nd	Submersible	65.7	13.15	1.8	0.8	5.3	22.2	241	237
VR-37	7/17/2000	0950	14.6	7.9	7.4	130	152	nd	Flowed	19.0	4.38	0.6	0.6	0.6	5.2	74	75

Table 5. Summary of water-quality field properties and major-element chemistry[1] in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Temp., field water temperature; ºC, degrees Celsius; O_2, dissolved oxygen; mg/L, milligrams per liter; Sp. Cond., specific conductance at 25ºC; µS/cm, microsiemens per centimeter; Q, discharge; gal/min, gallons per minute; ft, feet below NGVD29; Ca, calcium; Mg, magnesium, Na, sodium; K, potassium; Cl, chloride; SO_4, sulfate; HCO_3, total titration alkalinity as bicarbonate; nd, not determined; <, actual value is known to be less than value shown; E, estimated concentration; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Temp. (ºC)	O_2 (mg/L)	pH	Sp Cond (µS/cm)	Q (gal/min)	Pump setting (ft)	Pump type	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Cl (mg/L)	SO_4 (mg/L)	HCO_3 field (mg/L)	HCO_3 lab (mg/L)
VR-37d	7/17/2000	0955	14.6	7.9	7.4	130	152	nd	Flowed	19.1	4.35	0.6	0.6	0.6	5.2	74	75
VR-38	7/18/2000	0915	13.4	8.9	7.5	303	12	480	Submersible	35.4	19.40	0.5	0.7	1.1	5.2	203	201
VR-39	7/18/2000	1330	13.0	6.8	7.7	299	34	463	Submersible	28.2	21.77	1.2	2.1	4.5	8.4	185	183
VR-40	7/19/2000	0925	13.4	1.2	7.2	431	15	nd	Submersible	50.5	28.63	0.8	1.8	1.6	11.2	287	285
VR-41	7/19/2000	1125	12.9	1.1	7.1	449	22	nd	Submersible	56.6	33.83	1.1	1.7	1.5	11.0	341	336
VR-42	7/20/2000	1200	9.2	12.7	6.5	129	53	nd	Submersible	21.1	2.88	1.2	0.5	0.8	5.2	75	75
VR-42bt	7/20/2000	1205	nd	nd	nd	nd	nd	nd	nd	<0.1	0.00	<0.05	<0.1	<0.1	<0.2	nd	<1
VR-43	7/20/2000	1740	9.7	0.9	6.3	65	22	130	Submersible	4.6	2.92	0.3	0.9	0.6	2.3	38	32
VR-44	7/20/2000	0900	10.1	10.0	6.2	87	60	48	Submersible	15.0	1.59	1.4	0.6	2.2	1.8	48	48
VR-45	7/25/2000	0920	12.4	8.1	7.2	130	300	155	Submersible	14.4	7.75	0.5	2.3	0.9	2.0	86	84
VR-46	7/25/2000	1310	12.1	6.2	7.6	223	72	nd	nd	36.7	2.17	8.7	0.7	7.1	7.2	131	127
VR-47	7/26/2000	1015	12.7	6.8	8.2	122	1,800	230	Turbine	14.2	7.31	1.4	1.5	1.9	3.5	75	75
VTDW-01	9/16/1999	1505	14.9	4.9	5.1	69	2	nd	Submersible	3.5	1.62	3.0	3.7	2.2	10.7	18	15
VTDW-03A	7/15/2000	1300	14.8	2.3	7.2	149	3	nd	Bennett	18.3	2.53	3.8	6.3	1.4	10.2	69	74
VTDW-03B	7/15/2000	1700	13.4	3.5	7.3	135	3	nd	Bennett	18.3	2.29	3.8	6.0	1.5	9.7	74	71
VTDW-07A	7/14/2000	1430	13.6	1.7	7.2	128	3	nd	Bennett	15.6	2.57	3.9	7.1	2.0	5.0	69	71
VTDW-07B	7/14/2000	1610	15.0	10.4	7.0	116	3	nd	Bennett	12.9	2.58	3.8	6.5	2.2	4.8	61	62
VTDW-08	9/16/1999	1800	12.0	8.6	5.7	53	4	nd	Bennett	4.4	1.20	3.3	1.6	3.5	0.5	24	24

[1] Water samples collected by the Virginia Aquifer Susceptibility and Virginia Polytechnic Institute and State University Fractured Rock Hydrology studies for the determination of major-element chemistry were analyzed at the U.S. Geological Survey National Research Program Common Use Laboratory, Reston, Va. Water samples collected by the Virginia Beach Shallow Ground Water study for the determination of major-element chemistry were analyzed at the U.S. Geological Survey National Water-Quality Laboratory, Denver, Colo.

Table 6. Summary of minor-element chemistry[1], nitrate (NO_2+NO_3)[2], dissolved organic carbon, and radon-222 in water samples from wells and springs in Virginia, 1998-2000

[VAS, Virginia Aquifer Susceptibility study; Sr, strontium, SiO_2, silica; Fe^{2+}, iron; Mn, manganese; F, fluoride; NO_2+NO_3, nitrite plus nitrate; N, nitrogen; DOC, dissolved organic carbon; ^{222}Rn, radon-222; 2σ, 2 standard deviations; mg/L, milligrams per liter; pCi/L, picocuries per liter; nd, not determined; <, actual value is known to be less than value shown; E, estimated value; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	TIme	Sr (mg/L)	SiO_2 (mg/L)	Fe^{2+} (mg/L)	Mn (mg/L)	F (mg/L)	NO_2+NO_3 (mg/L as N)	DOC (mg/L)	^{222}Rn (pCi/L)	^{222}Rn error 2σ (pCi/L)
AP-01	7/1020/00	1045	0.568	14.4	0.96	0.064	0.2	<0.05	0.86	41	17
AP-02	7/10/2000	1400	0.434	12.9	8.79	0.531	<0.1	<0.05	0.76	<26	15
AP-03	7/20/2000	1045	1.332	9.15	0.06	0.008	0.2	0.91	0.67	274	21
AP-03d	7/20/2000	1050	1.306	9.10	0.06	0.008	0.2	0.91	0.72	258	21
AP-04	7/11/2000	1050	1.154	17.9	0.73	0.140	0.1	<0.05	0.88	81	19
AP-05	7/12/2000	0950	0.361	11.3	1.59	0.218	0.1	<0.05	0.95	53	15
AP-06	7/13/2000	0905	0.455	13.3	0.09	0.181	0.1	<0.05	0.95	<26	15
AP-07	7/13/2000	1445	0.664	22.4	1.49	0.069	<0.1	<0.05	12.00	74	15
AP-08	7/10/2000	0950	1.245	8.39	<0.02	0.021	0.2	0.15	0.55	192	20
AP-09	7/10/2000	1345	0.925	8.49	0.35	0.241	0.3	<0.05	2.10	32	16
AP-10	7/11/2000	1115	0.616	16.4	0.28	0.156	0.2	<0.05	1.00	84	19
AP-11	7/11/2000	1530	0.893	13.1	<0.02	0.104	0.2	<0.05	1.30	51	18
AP-12	7/12/2000	1140	0.377	14.4	0.04	0.011	0.3	<0.05	0.44	52	16
AP-13	7/12/2000	1430	0.621	19.8	0.57	0.072	0.1	<0.05	0.75	50	15
BR-01	7/19/1999	1100	0.282	23.2	0.04	0.048	0.5	0.17	0.30	573	26
BR-02	7/19/1999	1500	0.031	17.6	<0.02	0.004	0.1	0.32	0.20	160	18
BR-03	7/20/1999	0910	0.018	13.5	<0.02	0.000	0.1	0.30	0.20	175	19
BR-04	7/20/1999	1425	0.036	27.5	1.40	0.195	0.1	<0.05	0.50	297	21
BR-05	8/25/1999	1115	0.016	12.5	0.02	<0.001	<0.1	0.06	0.30	155	16
BR-06	9/13/1999	1715	0.417	39.6	0.68	0.642	0.2	<0.05	1.20	873	28
BR-07	9/14/1999	0940	0.210	26.3	0.62	0.315	0.2	0.14	0.50	641	25
BR-08	9/16/1999	0940	0.046	25.7	<0.02	0.003	<0.1	3.47	0.30	827	28
BR-09	10/18/1999	1720	0.083	35.7	4.92	1.300	0.1	<0.05	0.85	1,010	30
BR-10	10/26/1999	0947	0.267	32.9	1.70	0.503	0.1	<0.05	1.30	394	21
CP-01	6/23/1998	1338	0.002	39.0	0.08	0.006	0.7	<0.05	0.20	206	18
CP-01d	6/23/1998	1342	0.002	38.7	0.07	0.006	0.7	<0.05	0.20	207	19
CP-02	6/24/1998	1142	0.101	44.7	<0.010	<0.001	0.6	<0.05	0.30	322	23
CP-03	6/25/1998	1231	0.002	37.7	0.09	0.002	1.0	<0.05	0.40	308	22
CP-04	7/1/1998	1024	0.013	34.9	<0.010	<0.001	0.9	<0.05	0.30	260	20
CP-05	7/6/1998	1213	0.059	44.9	<0.010	<0.001	1.7	<0.05	0.90	1,040	32
CP-06	7/6/1998	1434	0.021	17.5	0.02	0.003	2.1	<0.05	0.40	196	19
CP-07	7/7/1998	1158	0.165	34.4	0.09	0.002	0.5	<0.05	0.50	277	21
CP-08	7/7/1998	1459	0.080	16.7	0.06	<0.001	1.3	<0.05	0.70	257	20
CP-09	7/8/1998	1159	1.172	38.2	0.76	0.080	0.4	<0.05	2.10	278	21
CP-10	7/8/1998	1505	0.121	31.5	0.12	0.002	1.3	<0.05	1.10	1,400	36
CP-11	7/9/1998	1121	0.350	22.8	0.26	0.015	0.2	<0.05	0.60	707	27
CP-11b	7/9/1998	1126	<0.001	nd	<0.010	<0.001	<0.07	<0.05	0.20	705	27
CP-12	7/14/1998	1327	0.156	42.8	0.01	0.008	0.1	<0.05	0.60	186	19
CP-13	7/15/1998	0920	0.620	17.7	0.53	0.009	0.1	<0.05	1.70	277	23
CP-14	7/15/1998	1220	0.087	14.9	0.01	0.001	<0.07	1.88	0.20	377	24
CP-15	7/15/1998	1410	0.723	18.2	0.86	0.011	0.1	<0.05	2.00	309	22
CP-16	7/16/1998	1008	0.196	30.9	0.11	0.025	0.1	<0.05	1.40	372	22

Table 6. Summary of minor-element chemistry[1], nitrate (NO_2+NO_3)[2], dissolved organic carbon, and radon-222 in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Sr, strontium, SiO_2, silica; Fe^{2+}, iron; Mn, manganese; F, fluoride; NO_2+NO_3, nitrite plus nitrate; N, nitrogen; DOC, dissolved organic carbon; ^{222}Rn, radon-222; 2σ, 2 standard deviations; mg/L, milligrams per liter; pCi/L, picocuries per liter; nd, not determined; <, actual value is known to be less than value shown; E, estimated value; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	TIme	Sr (mg/L)	SiO_2 (mg/L)	Fe^{2+} (mg/L)	Mn (mg/L)	F (mg/L)	NO_2+NO_3 (mg/L as N)	DOC (mg/L)	^{222}Rn (pCi/L)	^{222}Rn error 2σ (pCi/L)
CP-17	7/16/1998	1351	0.254	37.5	0.20	0.078	0.2	<0.05	1.90	194	19
CP-18	7/27/1998	1117	0.815	34.3	0.04	0.017	0.2	<0.05	0.20	170	19
CP-19	7/27/1998	1545	0.436	40.3	0.14	0.082	0.2	<0.05	0.20	205	19
CP-20	7/28/1998	1102	0.019	15.9	0.05	0.004	4.6	0.09	0.40	197	19
CP-21	7/29/1998	1059	0.282	36.2	3.03	0.156	0.1	<0.05	1.60	342	22
CP-22	7/30/1998	1048	0.083	43.5	0.10	0.016	0.2	<0.05	0.20	248	30
CP-23	8/3/1998	1126	0.162	46.2	0.28	0.017	0.4	<0.05	0.40	607	26
CP-23d	8/3/1998	1131	0.163	46.3	0.28	0.017	0.4	<0.05	0.40	596	26
CP-24	8/4/1998	0936	0.048	18.8	0.01	0.003	2.6	0.07	0.40	234	20
CP-25	8/4/1998	1440	0.076	41.1	0.01	<0.001	0.8	0.06	0.40	164	18
CP-26	8/5/1998	1325	0.073	6.77	0.02	0.032	<0.07	9.92	0.40	378	23
CP-27	8/6/1998	1001	0.162	18.2	0.06	0.008	2.3	<0.05	0.70	248	20
CP-28	8/17/1998	1015	0.228	56.1	1.08	0.304	0.3	<0.05	0.30	359	24
CP-29	8/17/1998	1340	0.004	28.2	0.01	<0.001	0.2	<0.05	0.20	314	23
CP-30	8/18/1998	1000	0.006	32.4	0.11	0.005	0.3	0.05	0.20	229	21
CP-31	8/19/1998	1620	0.004	27.3	0.02	0.007	0.4	<0.05	0.20	225	19
CP-32	8/31/1998	1053	0.006	23.1	0.02	0.002	1.1	<0.05	0.30	212	19
CP-33	8/31/1998	1453	0.188	37.0	0.70	0.098	0.1	<0.05	0.30	203	19
CP-34	8/31/1998	1731	0.035	46.4	1.98	0.034	0.1	<0.05	0.50	232	19
CP-34d	8/31/1998	1736	0.035	46.9	1.99	0.034	0.1	<0.05	0.10	241	19
CP-35	9/1/1998	1038	0.010	23.7	0.11	0.029	0.8	<0.05	0.20	265	20
CP-36	9/1/1998	1545	0.039	32.9	0.04	0.004	1.2	<0.05	0.30	251	20
CP-37	9/2/1998	0950	0.215	18.1	0.24	0.031	0.2	<0.05	0.30	492	24
CP-38	9/2/1998	1259	0.132	22.2	0.11	0.018	0.3	<0.05	0.20	423	23
CP-39	9/2/1998	1548	0.316	43.2	0.07	0.051	0.3	<0.05	0.30	285	20
CP-40	9/3/1998	0919	0.017	33.8	0.01	0.003	0.9	<0.05	0.30	331	22
CP-41	9/10/1998	1115	0.006	25.5	0.05	0.003	1.9	<0.05	0.30	276	22
CP-42	9/10/1998	1440	0.016	12.7	0.03	0.009	1.2	<0.05	0.20	236	21
CP-43	10/1/1998	1135	0.034	18.1	0.03	0.002	1.2	0.08	0.80	147	17
CP-44	10/5/1998	1110	0.041	11.0	0.07	0.005	1.9	<0.05	0.50	197	19
CP-45	10/5/1998	1505	0.235	23.7	2.79	0.300	0.3	<0.05	0.50	277	20
CP-46	10/6/1998	1020	0.009	21.8	<0.010	0.007	0.1	1.72	0.20	670	27
CP-47	10/6/1998	1430	0.032	35.1	0.14	0.008	0.8	<0.05	0.60	198	19
CP-48	10/7/1998	1027	0.025	10.3	<0.010	0.032	0.1	4.05	0.30	434	22
CP-49	10/27/1998	1025	0.372	14.9	0.57	0.047	0.1	0.05	0.10	745	27
CP-50	10/28/1998	1205	0.016	9.35	0.01	0.025	0.1	2.93	0.20	287	22
CP-51	11/4/1998	1220	0.814	43.9	0.35	0.052	0.9	<0.05	<0.1	296	20
CP-51d	11/4/1998	1225	0.815	43.4	0.35	0.054	0.9	<0.05	0.30	271	20
PD-01	6/28/1999	1435	0.094	25.2	<0.02	0.007	1.6	<0.05	0.20	2,970	51
PD-02	6/29/1999	1530	0.114	35.7	1.27	0.144	0.1	<0.05	0.20	3,430	57
PD-03	6/30/1999	1030	0.075	28.0	0.03	0.048	<0.10	0.15	0.20	418	22
PD-04	6/30/1999	1500	0.071	26.1	<0.02	0.023	0.1	0.05	0.20	2,880	49

Table 6. Summary of minor-element chemistry[1], nitrate (NO_2+NO_3)[2], dissolved organic carbon, and radon-222 in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Sr, strontium, SiO_2, silica; Fe^{2+}, iron; Mn, manganese; F, fluoride; NO_2+NO_3, nitrite plus nitrate; N, nitrogen; DOC, dissolved organic carbon; ^{222}Rn, radon-222; 2σ, 2 standard deviations; mg/L, milligrams per liter; pCi/L, picocuries per liter; nd, not determined; <, actual value is known to be less than value shown; E, estimated value; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	TIme	Sr (mg/L)	SiO_2 (mg/L)	Fe^{2+} (mg/L)	Mn (mg/L)	F (mg/L)	NO_2+NO_3 (mg/L as N)	DOC (mg/L)	^{222}Rn (pCi/L)	^{222}Rn error 2σ (pCi/L)
PD-05	7/1/1999	1240	0.097	29.1	3.36	0.242	<0.10	<0.05	0.30	7,530	83
PD-06	8/23/1999	1245	0.100	21.1	0.67	0.192	<0.1	<0.05	0.20	3,640	54
PD-07	8/23/1999	1515	0.035	18.7	5.16	1.205	<0.1	<0.05	0.10	1,280	33
PD-08	8/30/1999	1100	0.515	34.2	0.04	0.001	1.1	0.70	0.50	7,260	78
PD-09	8/31/1999	1045	0.471	31.2	0.11	0.088	0.1	<0.05	1.40	790	27
PD-10	9/1/1999	1045	0.055	15.9	<0.02	0.007	<0.1	2.88	0.30	2,170	43
PD-11	9/1/1999	1350	0.093	37.9	<0.02	<0.001	0.1	2.60	0.20	3,320	52
PD-12	9/1/1999	1720	0.213	34.9	1.08	0.332	0.3	<0.05	0.70	6,820	72
PD-13	9/2/1999	1030	0.016	15.7	<0.02	<0.001	<0.1	0.37	0.20	462	22
PD-14	9/2/1999	1230	0.018	15.5	<0.02	0.001	<0.1	0.62	0.20	810	28
PD-15	9/2/1999	1545	0.023	40.6	3.09	0.259	0.5	<0.05	0.20	2,300	43
PD-15d	9/2/1999	1550	0.022	41.1	2.98	0.252	0.5	<0.05	0.20	2,220	43
PD-16	9/13/1999	1035	3.140	27.4	0.25	0.072	0.4	0.91	0.60	1,210	33
PD-17	9/13/1999	1448	1.000	26.1	0.08	0.098	0.1	0.07	0.40	1,730	37
PD-18	10/18/1999	1030	0.214	20.8	0.03	0.136	0.1	0.06	0.55	691	27
PD-19	10/19/1999	1130	0.178	10.2	<0.02	<0.001	<0.1	0.38	0.38	451	22
PD-20	10/19/1999	1545	0.069	41.7	3.90	0.354	0.2	<0.05	0.50	792	26
PD-20b	10/20/1999	0800	<0.001	1.22	<0.02	0.002	<0.1	<0.05	<0.33	nd	nd
PD-21	10/25/1999	0920	0.061	26.3	0.03	0.085	0.2	<0.05	E0.19	850	29
PD-22	10/25/1999	1240	0.030	16.7	<0.2	0.030	<0.1	0.08	E0.23	2,810	48
PD-23	10/25/1999	1722	2.580	25.9	<0.2	0.017	0.1	1.06	0.68	1,940	40
PD-24	10/26/1999	1324	0.108	13.4	0.02	<0.001	<0.1	4.08	0.55	239	18
PD-25	6/27/2000	1035	0.087	37.0	<0.02	<0.001	<0.1	1.05	E0.16	2,840	49
PD-26	6/27/2000	1500	0.056	27.7	<0.02	0.001	0.1	0.78	E0.16	979	30
PD-27	6/28/2000	0920	1.164	20.7	<0.02	0.007	0.5	0.07	0.85	4,060	58
PD-28	6/28/2000	1440	0.054	28.9	0.09	0.146	0.2	<0.05	<0.33	1,910	41
PD-29	6/29/2000	1130	0.149	36.0	2.96	0.384	<0.1	<0.05	E0.21	174	18
PD-30	6/29/2000	1540	0.113	42.6	0.34	0.239	0.2	<0.05	E0.18	457	22
VB-01	5/13/1999	1615	nd	24.7	0.13	0.004	0.2	0.01	1.30	nd	nd
VB-02	5/14/1999	1115	nd	23.8	4.26	0.165	0.1	0.01	0.60	nd	nd
VB-03	5/10/1999	1830	nd	41.0	5.39	0.198	0.1	0.01	1.30	nd	nd
VB-04	5/12/1999	1230	nd	39.9	1.07	0.097	0.2	<0.005	1.20	nd	nd
VB-05	8/14/2000	1415	nd	12.3	1.24	0.009	<0.1	<0.005	4.20	nd	nd
VB-05b	8/14/2000	1410	nd	nd	<0.01	<0.002	<0.1	<0.005	<0.33	nd	nd
VB-06	8/11/2000	1000	nd	57.1	8.74	0.279	0.2	<0.005	1.50	nd	nd
VB-07	8/10/2000	1110	nd	37.4	3.37	0.043	0.6	<0.005	6.60	nd	nd
VB-08	8/9/2000	1130	nd	38.8	5.02	0.164	0.3	<0.005	6.30	nd	nd
VB-09	8/16/2000	1520	nd	20.9	0.74	0.011	0.2	0.01	5.60	nd	nd
VB-10	8/17/2000	1045	nd	29.2	0.63	0.008	0.3	<0.005	3.90	nd	nd
VB-11	8/16/2000	0945	nd	40.6	1.26	0.041	0.7	<0.005	6.20	nd	nd
VB-12	8/15/2000	1115	nd	50.3	0.56	0.187	<0.1	<0.005	0.96	nd	nd
VB-13	8/8/2000	1225	nd	34.7	0.94	0.083	0.2	<0.005	1.30	nd	nd

Table 6. Summary of minor-element chemistry[1], nitrate (NO_2+NO_3)[2], dissolved organic carbon, and radon-222 in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Sr, strontium, SiO_2, silica; Fe^{2+}, iron; Mn, manganese; F, fluoride; NO_2+NO_3, nitrite plus nitrate; N, nitrogen; DOC, dissolved organic carbon; ^{222}Rn, radon-222; 2σ, 2 standard deviations; mg/L, milligrams per liter; pCi/L, picocuries per liter; nd, not determined; <, actual value is known to be less than value shown; E, estimated value; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	TIme	Sr (mg/L)	SiO_2 (mg/L)	Fe^{2+} (mg/L)	Mn (mg/L)	F (mg/L)	NO_2+NO_3 (mg/L as N)	DOC (mg/L)	^{222}Rn (pCi/L)	^{222}Rn error 2σ (pCi/L)
VB-14	8/7/2000	1745	nd	31.1	0.88	0.053	0.2	<0.005	1.60	nd	nd
VB-14d	8/7/2000	1750	nd	31.3	0.88	0.053	0.2	<0.005	1.40	nd	nd
VR-01	7/6/1999	1230	0.016	11.5	<0.02	0.001	0.1	<0.05	0.30	146	17
VR-02	7/6/1999	1615	0.046	12.0	<0.02	0.003	0.1	0.75	0.50	240	18
VR-03	7/7/1999	1035	0.019	7.60	<0.02	0.002	<0.10	0.45	0.20	252	20
VR-03d	7/7/1999	1040	0.018	7.58	<0.02	<0.001	<0.10	0.45	0.20	258	20
VR-04	7/7/1999	1400	0.091	9.40	<0.02	0.002	0.1	0.57	0.20	241	19
VR-05	7/8/1999	1015	0.088	7.56	0.03	0.008	0.1	0.57	0.60	316	22
VR-06	7/8/1999	1620	0.116	10.2	0.03	0.003	0.1	nd	0.40	nd	nd
VR-07	7/8/1999	1820	0.055	10.6	<0.02	0.003	0.1	nd	0.40	nd	nd
VR-08	7/9/1999	1015	0.178	13.6	<0.02	0.005	0.2	nd	0.30	nd	nd
VR-09	7/9/1999	1300	0.169	14.2	0.02	0.002	0.2	nd	0.20	nd	nd
VR-10	7/9/1999	1500	0.108	11.5	<0.02	0.003	0.1	nd	0.40	nd	nd
VR-11	7/9/1999	1645	0.016	13.0	<0.02	0.002	0.1	nd	0.30	nd	nd
VR-12	7/21/1999	0945	0.013	9.33	0.03	<0.001	0.1	2.74	0.30	271	19
VR-13	7/21/1999	1250	0.082	8.67	0.03	<0.001	0.2	4.76	0.60	274	19
VR-14	7/22/1999	1200	0.014	9.21	<0.02	<0.001	0.1	0.08	0.30	413	32
VR-15	8/10/1999	1400	0.264	12.2	<0.02	0.003	0.3	<0.05	0.30	62	14
VR-15bt	8/10/1999	1405	<0.001	nd	<0.02	<0.001	<0.1	<0.05	<0.1	nd	nd
VR-16	8/11/1999	1330	0.223	18.5	0.15	0.313	0.2	<0.05	0.70	130	15
VR-17	8/11/1999	1630	1.370	9.97	0.04	<0.001	0.2	3.38	0.70	372	20
VR-18	8/12/1999	1130	0.910	9.20	<0.02	0.006	0.1	<0.05	0.50	101	15
VR-19	8/24/1999	1050	0.011	7.40	0.01	<0.001	<0.1	0.75	0.30	137	18
VR-20	8/24/1999	1315	0.065	7.09	0.03	<0.001	<0.1	2.82	0.60	445	24
VR-21	8/25/1999	1530	4.910	7.84	0.09	<0.001	1.4	0.24	0.40	370	20
VR-22	8/26/1999	0925	0.088	8.06	0.01	<0.001	<0.1	0.59	0.30	393	30
VR-23	8/26/1999	1400	4.480	32.3	0.20	0.038	0.8	<0.05	0.50	274	26
VR-24	10/27/1999	0925	0.357	21.8	<0.02	0.258	0.1	<0.05	0.45	294	20
VR-25	10/27/1999	1340	0.165	15.4	<0.02	0.086	0.5	<0.05	0.47	136	16
VR-26	10/28/1999	1010	0.038	6.67	<0.02	0.002	<0.1	<0.05	E0.21	318	29
VR-27	10/28/1999	1345	0.192	6.50	<0.02	0.002	<0.1	<0.05	E0.32	499	33
VR-28	7/12/2000	1415	0.301	15.2	0.12	0.117	0.1	<0.05	0.82	146	17
VR-29	7/13/2000	1108	0.053	22.1	7.38	0.233	0.1	<0.05	0.38	206	18
VR-30	7/13/2000	1415	0.200	9.26	0.16	0.093	0.2	<0.05	E0.22	128	17
VR-31	7/17/2000	0950	1.640	16.7	0.03	0.026	0.2	<0.05	0.55	53	16
VR-32	7/17/2000	1321	0.067	8.63	<0.02	<0.001	0.3	0.12	0.44	536	25
VR-33	7/18/2000	1030	0.226	6.72	<0.02	<0.001	<0.1	0.40	0.58	646	28
VR-34	7/18/2000	1400	0.103	15.0	0.02	0.035	0.2	<0.05	E0.24	<26	16
VR-35	7/19/2000	0915	0.044	8.72	3.76	1.404	0.2	<0.05	E0.28	144	19
VR-35b	7/19/2000	1000	<0.005	0.00	<0.02	<0.001	<0.1	<0.05	E0.17	nd	nd
VR-36	7/20/2000	1430	0.084	6.49	<0.02	<0.001	0.2	1.04	0.53	395	23
VR-37	7/17/2000	0950	0.517	7.37	<0.02	<0.001	<0.1	0.13	E0.21	135	19

Table 6. Summary of minor-element chemistry[1], nitrate (NO_2+NO_3)[2], dissolved organic carbon, and radon-222 in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Sr, strontium, SiO_2, silica; Fe^{2+}, iron; Mn, manganese; F, fluoride; NO_2+NO_3, nitrite plus nitrate; N, nitrogen; DOC, dissolved organic carbon; ^{222}Rn, radon-222; 2σ, 2 standard deviations; mg/L, milligrams per liter; pCi/L, picocuries per liter; nd, not determined; <, actual value is known to be less than value shown; E, estimated value; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	TIme	Sr (mg/L)	SiO_2 (mg/L)	Fe^{2+} (mg/L)	Mn (mg/L)	F (mg/L)	NO_2+NO_3 (mg/L as N)	DOC (mg/L)	^{222}Rn (pCi/L)	^{222}Rn error 2σ (pCi/L)
VR-37d	7/17/2000	0955	0.512	7.29	<0.02	<0.001	<0.1	0.12	E0.32	62	18
VR-38	7/18/2000	0915	0.012	5.89	<0.02	<0.001	<0.1	0.28	E0.27	551	28
VR-39	7/18/2000	1330	0.043	8.24	<0.02	<0.001	0.1	0.74	E0.18	1,130	34
VR-40	7/19/2000	0925	0.038	9.68	<0.02	<0.005	0.3	0.06	E0.32	315	22
VR-41	7/19/2000	1125	0.175	10.5	0.04	0.007	0.3	0.05	0.35	362	23
VR-42	7/20/2000	1200	0.055	6.58	<0.02	<0.005	<0.1	0.43	E0.31	754	29
VR-42bt	7/20/2000	1205	<0.005	.13	<0.02	<0.005	<0.1	<0.05	0.73	nd	nd
VR-43	7/20/2000	1740	0.001	6.48	2.68	1.212	0.4	<0.05	E0.3	267	20
VR-44	7/20/2000	0900	0.042	9.36	<0.02	<0.005	<0.1	0.83	E0.18	1,540	39
VR-45	7/25/2000	0920	0.022	8.98	<0.02	<0.005	0.2	0.16	0.60	906	34
VR-46	7/25/2000	1310	0.249	7.95	<0.02	0.007	<0.1	<0.05	E0.29	152	21
VR-47	7/26/2000	1015	0.016	7.47	<0.02	<0.005	<0.1	0.47	E0.19	104	18
VTDW-01	9/16/1999	1505	0.023	21.9	1.14	0.033	0.1	0.67	0.20	nd	nd
VTDW-03A	7/15/2000	1300	0.053	22.3	0.72	0.072	0.2	<0.05	nd	nd	nd
VTDW-03B	7/15/2000	1700	0.046	22.6	0.23	0.087	0.2	0.00	nd	nd	nd
VTDW-07A	7/14/2000	1430	0.037	20.1	0.08	0.077	0.1	<0.05	nd	nd	nd
VTDW-07B	7/14/2000	1610	0.034	21.8	0.03	0.065	0.1	0.07	nd	nd	nd
VTDW-08	9/16/1999	1800	0.020	22.5	<0.02	0.028	<0.1	0.33	1.60	nd	nd

Table 7. Summary of trace-element chemistry[1] in water samples from wells and springs in Virginia, 1998-2000

[VAS, Virginia Aquifer Susceptibility study; Al, aluminum; B, boron; Ba, barium; Br, bromide; Li, lithium; Zn, zinc; Pb, lead; Cu, copper; Ni, nickel; Rb, rubidium; V, vanadium; mg/L, milligrams per liter; mg/L, micrograms per liter; <, actual value is known to be less than value shown; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Al (mg/L)	B (mg/L)	Ba (mg/L)	Br (mg/L)	Li (mg/L)	Zn (μg/L)	Pb (μg/L)	Cu (μg/L)	Ni (μg/L)	Rb (μg/L)	V (μg/L)
AP-01	7/10/2000	1045	0.007	0.04	0.346	<0.05	0.019	8	<0.05	0.1	0.5	2.9	0.4
AP-02	7/10/2000	1400	0.007	0.04	0.540	<0.05	0.014	27	<0.05	0.5	0.8	4.0	0.6
AP-03	7/20/2000	1045	<0.001	0.06	0.031	<0.05	0.014	71	<0.05	0.3	2.1	0.5	0.5
AP-03d	7/20/2000	1050	<0.001	0.06	0.031	<0.05	0.015	69	<0.05	0.3	2.1	0.5	0.8
AP-04	7/11/2000	1050	0.008	0.03	0.891	<0.05	0.035	20	<0.05	0.3	1.0	4.5	0.4
AP-05	7/12/2000	950	0.008	0.04	0.597	<0.05	0.016	19	<0.05	0.3	0.6	3.8	0.9
AP-06	7/13/2000	905	0.007	0.03	0.272	<0.05	0.024	15	<0.05	0.3	0.9	2.8	0.4
AP-07	7/13/2000	1445	0.004	0.02	0.597	0.22	0.007	57	<0.05	0.4	0.7	4.2	0.9
AP-08	7/10/2000	950	<0.001	0.04	0.096	<0.05	0.009	29	<0.05	0.3	0.8	0.4	0.8
AP-09	7/10/2000	1345	0.005	0.02	0.242	<0.05	0.112	9	<0.05	0.3	0.7	4.4	1.9
AP-10	7/11/2000	1115	<0.001	<0.02	0.578	<0.05	0.035	12	<0.05	0.4	0.7	3.3	0.8
AP-11	7/11/2000	1530	0.001	<0.02	0.601	<0.05	0.035	13	<0.05	0.4	0.9	5.2	1.3
AP-12	7/12/2000	1140	<0.001	<0.02	0.456	<0.05	0.013	12	<0.05	1.5	0.2	2.7	0.2
AP-13	7/12/2000	1430	0.002	<0.02	0.578	<0.05	0.013	86	0.06	3.8	0.6	4.0	0.2
BR-01	7/19/1999	1100	0.006	0.02	0.002	<0.05	0.008	80	0.16	0.5	0.5	6.0	0.4
BR-02	7/19/1999	1500	0.007	<0.02	0.051	<0.05	<0.001	104	0.11	13.1	0.5	1.1	0.3
BR-03	7/20/1999	910	0.006	0.02	0.004	<0.05	<0.001	35	0.20	2.4	0.1	0.3	0.8
BR-04	7/20/1999	1425	0.006	<0.02	0.047	<0.05	0.003	42	<0.05	<0.1	23.0	6.3	0.1
BR-05	8/25/1999	1115	0.008	<0.02	0.059	<0.05	0.001	2	<0.05	0.2	0.7	3.5	0.6
BR-06	9/13/1999	1715	0.008	0.03	0.107	0.15	0.021	15	0.07	0.5	2.4	13.8	1.0
BR-07	9/14/1999	940	0.008	0.03	0.083	<0.05	0.007	12	<0.05	0.4	1.6	6.4	0.8
BR-08	9/16/1999	940	0.009	0.02	0.057	<0.05	<0.001	23	<0.05	4.7	6.3	0.8	1.5
BR-09	10/18/1999	1720	0.008	<0.02	0.175	<0.05	0.003	134	<0.05	0.4	16.5	10.1	0.3
BR-10	10/26/1999	947	0.010	0.03	0.044	0.05	0.006	19	0.06	0.3	2.1	39.0	0.7
CP-01	6/23/1998	1338	0.007	0.10	0.002	<0.02	0.004	13	<0.05	<0.1	0.9	0.5	0.3
CP-01d	6/23/1998	1342	0.007	0.10	0.002	<0.02	0.004	13	<0.05	<0.1	1.0	0.5	0.3
CP-02	6/24/1998	1142	0.007	0.21	<0.001	<0.02	0.023	<1	<0.05	<0.1	0.2	2.6	0.3
CP-03	6/25/1998	1231	0.006	0.35	0.002	<0.02	0.003	2	<0.05	<0.1	0.6	0.5	0.4
CP-04	7/1/1998	1024	0.007	0.39	0.002	<0.02	0.004	2	0.14	0.2	0.9	1.4	0.7
CP-05	7/6/1998	1213	0.007	0.69	<0.001	<0.02	0.016	<1	<0.05	<0.1	0.3	2.1	0.7
CP-06	7/6/1998	1434	0.009	0.81	0.009	<0.02	0.008	1	0.07	0.2	1.2	1.3	1.3
CP-07	7/7/1998	1158	0.007	0.20	<0.001	<0.02	0.016	3	0.07	0.2	0.2	3.4	0.5
CP-08	7/7/1998	1459	0.007	0.66	<0.001	<0.02	0.015	1	0.09	0.1	0.2	2.8	0.9
CP-09	7/8/1998	1159	0.008	0.14	0.007	1.08	0.045	103	0.29	1.7	0.8	3.4	<0.1
CP-10	7/8/1998	1505	0.007	0.64	0.008	<0.02	0.023	<1	<0.05	<0.1	0.5	2.7	0.8
CP-11	7/9/1998	1121	0.007	0.08	0.002	0.08	0.011	5	<0.05	0.2	0.1	2.0	0.1
CP-11b	7/9/1998	1126	0.007	0.02	<0.001	<0.02	<0.001	7	0.13	0.5	0.1	<0.1	<0.1
CP-12	7/14/1998	1327	0.010	0.02	0.002	0.06	0.007	8	1.90	4.8	1.2	0.9	<0.1
CP-13	7/15/1998	920	0.011	0.17	0.004	0.33	0.009	3	0.10	0.3	0.9	4.0	<0.1
CP-14	7/15/1998	1220	0.007	0.03	0.026	0.07	0.001	11	1.40	1.1	1.0	2.4	0.3
CP-15	7/15/1998	1410	0.007	0.21	0.006	0.62	0.011	2	<0.5	<0.1	1.2	4.3	<0.1
CP-16	7/16/1998	1008	0.006	0.09	0.003	<0.02	0.008	1	0.11	<0.1	0.8	1.4	<0.1
CP-17	7/16/1998	1351	0.008	0.14	0.011	0.09	0.008	4	0.09	0.1	1.0	1.9	0.1
CP-18	7/27/1998	1117	0.008	0.05	0.086	<0.02	0.018	4	0.23	0.8	1.4	5.6	<0.1

Table 7. Summary of trace-element chemistry[1] in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Al, aluminum; B, boron; Ba, barium; Br, bromide; Li, lithium; Zn, zinc; Pb, lead; Cu, copper; Ni, nickel; Rb, rubidium; V, vanadium; mg/L, milligrams per liter; mg/L, micrograms per liter; <, actual value is known to be less than value shown; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Al (mg/L)	B (mg/L)	Ba (mg/L)	Br (mg/L)	Li (mg/L)	Zn (μg/L)	Pb (μg/L)	Cu (μg/L)	Ni (μg/L)	Rb (μg/L)	V (μg/L)
CP-19	7/27/1998	1545	0.008	0.04	0.092	<0.02	0.008	19	<0.05	<0.1	1.2	4.2	<0.1
CP-20	7/28/1998	1102	0.014	1.24	0.005	0.08	0.007	2	0.12	<0.1	0.2	2.3	<0.1
CP-21	7/29/1998	1059	0.007	0.04	0.016	0.06	0.008	3	<0.05	<0.1	1.3	1.4	0.1
CP-22	7/30/1998	1048	0.007	0.11	0.086	<0.02	0.005	7	<0.05	<0.1	0.2	3.2	<0.1
CP-23	8/3/1998	1126	0.008	0.09	0.011	<0.02	0.016	2	0.08	<0.1	0.5	3.4	<0.1
CP-23d	8/3/1998	1131	0.008	0.09	0.011	<0.02	0.016	1	0.05	<0.1	0.5	3.4	<0.1
CP-24	8/4/1998	936	0.008	0.85	0.002	0.24	0.009	3	0.06	<0.1	0.1	2.8	0.2
CP-25	8/4/1998	1440	0.008	0.26	<0.001	<0.02	0.020	5	0.16	0.5	0.2	2.4	0.2
CP-26	8/5/1998	1325	0.073	0.03	0.128	<0.02	0.002	36	5.10	5.8	1.3	2.9	<0.1
CP-27	8/6/1998	1001	0.008	1.36	0.031	1.32	0.025	12	0.13	0.1	0.2	3.8	<0.1
CP-28	8/17/1998	1015	0.007	0.06	0.083	0.11	0.022	5	<0.05	0.3	1.0	6.4	<0.1
CP-29	8/17/1998	1340	0.007	0.10	0.004	<0.02	0.004	14	0.10	0.1	0.1	0.9	<0.1
CP-30	8/18/1998	1000	0.007	0.09	0.004	<0.02	0.004	6	<0.05	<0.1	<0.1	1.1	<0.1
CP-31	8/19/1998	1620	0.007	0.12	0.008	<0.02	0.003	12	<0.05	<0.1	0.1	0.3	<0.1
CP-32	8/31/1998	1053	0.007	0.59	0.003	<0.02	0.004	2	0.06	0.3	0.2	1.0	<0.1
CP-33	8/31/1998	1453	0.007	0.03	0.188	<0.02	0.022	10	<0.05	0.1	0.1	4.6	<0.1
CP-34	8/31/1998	1731	0.007	0.01	0.050	<0.02	0.021	7	0.36	0.3	0.1	5.8	<0.1
CP-34d	8/31/1998	1736	0.007	0.01	0.049	<0.02	0.021	7	0.30	0.2	0.2	5.8	<0.1
CP-35	9/1/1998	1038	0.007	0.21	0.015	0.45	0.009	4	<0.05	<0.1	0.6	0.9	<0.1
CP-36	9/1/1998	1545	0.008	0.55	0.004	<0.02	0.005	4	0.10	<0.1	0.4	2.3	<0.1
CP-37	9/2/1998	950	0.007	0.11	0.074	<0.02	0.006	37	0.25	0.1	0.3	6.5	<0.1
CP-38	9/2/1998	1259	0.011	0.13	0.034	<0.02	0.007	6	0.06	<0.1	0.3	3.3	<0.1
CP-39	9/2/1998	1548	0.006	0.06	0.018	<0.02	0.014	7	0.05	<0.1	0.2	3.4	<0.1
CP-40	9/3/1998	919	0.007	0.36	0.002	<0.02	0.004	5	0.13	<0.1	0.8	1.4	<0.1
CP-41	9/10/1998	1115	0.007	0.56	0.010	<0.02	0.004	2	<0.05	0.1	0.5	1.0	0.1
CP-42	9/10/1998	1440	0.009	0.43	0.008	<0.02	0.005	<1	0.06	<0.1	0.8	1.4	<0.1
CP-43	10/1/1998	1135	0.008	0.59	<0.001	<0.02	0.012	<1	0.12	<0.1	0.4	2.1	<0.1
CP-44	10/5/1998	1110	0.007	1.40	0.018	<0.02	0.006	2	0.14	0.2	1.2	3.4	0.3
CP-45	10/5/1998	1505	0.007	0.03	0.006	<0.02	0.004	7	<0.05	<0.1	0.2	0.8	0.1
CP-46	10/6/1998	1020	0.008	0.02	0.040	<0.02	<0.001	11	4.19	7.2	0.7	5.2	<0.1
CP-47	10/6/1998	1430	0.007	0.23	0.002	<0.02	0.005	5	0.07	<0.1	0.3	1.1	<0.1
CP-48	10/7/1998	1027	0.038	0.02	0.178	<0.02	<0.001	44	1.61	17.2	0.8	6.7	<0.1
CP-49	10/27/1998	1025	0.006	0.02	0.015	<0.05	0.003	19	<0.05	0.3	0.1	0.6	0.8
CP-50	10/28/1998	1205	0.006	0.02	0.097	<0.05	0.001	51	7.70	10.6	1.5	3.1	<0.1
CP-51	11/4/1998	1220	0.042	1.40	0.078	6.43	0.059	9	0.16	0.7	0.8	5.8	0.7
CP-51d	11/4/1998	1225	0.042	1.20	0.076	6.44	0.055	11	0.19	0.7	0.8	5.8	0.7
PD-01	6/28/1999	1435	0.009	0.02	0.005	<0.05	0.027	13	0.08	0.5	<0.1	2.1	1.1
PD-02	6/29/1999	1530	0.007	<0.02	0.048	<0.05	0.024	18	<0.05	<0.1	0.4	2.3	0.1
PD-03	6/30/1999	1030	0.006	<0.02	0.022	<0.05	<0.001	27	<0.05	0.5	0.1	0.9	0.5
PD-04	6/30/1999	1500	0.007	<0.02	0.037	<0.05	0.005	18	0.07	<0.1	<0.1	2.1	0.2
PD-05	7/1/1999	1240	0.009	0.02	0.017	<0.05	0.011	26	0.30	<0.1	3.9	2.1	0.1
PD-06	8/23/1999	1245	0.007	0.02	0.019	<0.05	0.005	9	<0.05	0.6	3.3	1.1	0.4
PD-07	8/23/1999	1515	0.008	0.02	0.008	<0.05	0.009	253	0.16	0.1	19.7	0.8	0.2
PD-08	8/30/1999	1100	0.009	0.03	0.002	<0.05	0.053	32	0.21	1.3	0.8	0.6	3.4

Table 7. Summary of trace-element chemistry[1] in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Al, aluminum; B, boron; Ba, barium; Br, bromide; Li, lithium; Zn, zinc; Pb, lead; Cu, copper; Ni, nickel; Rb, rubidium; V, vanadium; mg/L, milligrams per liter; mg/L, micrograms per liter; <, actual value is known to be less than value shown; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Al (mg/L)	B (mg/L)	Ba (mg/L)	Br (mg/L)	Li (mg/L)	Zn (μg/L)	Pb (μg/L)	Cu (μg/L)	Ni (μg/L)	Rb (μg/L)	V (μg/L)
PD-09	8/31/1999	1045	0.008	0.08	0.343	0.14	0.017	15	0.10	0.5	1.3	6.2	1.2
PD-10	9/1/1999	1045	0.020	0.02	0.091	<0.05	0.001	8	0.20	1.8	2.3	5.4	0.6
PD-11	9/1/1999	1350	0.010	0.02	0.036	<0.05	0.006	20	0.40	3.0	1.9	0.5	2.7
PD-12	9/1/1999	1720	0.012	0.10	0.043	0.32	0.015	30	1.38	1.2	1.6	3.4	0.5
PD-13	9/2/1999	1030	0.008	0.02	0.029	<0.05	<0.001	2	0.10	0.8	0.3	1.6	1.1
PD-14	9/2/1999	1230	0.008	<0.02	0.044	<0.05	<0.001	41	0.29	2.7	0.5	2.1	1.0
PD-15	9/2/1999	1545	0.007	0.02	0.027	<0.05	0.015	11	<0.05	<0.1	0.4	7.8	0.2
PD-15d	9/2/1999	1550	0.007	<0.02	0.027	<0.05	0.015	10	<0.05	0.2	0.5	7.6	0.2
PD-16	9/13/1999	1035	0.008	1.07	0.051	0.05	0.045	12	0.05	1.8	4.4	3.6	3.0
PD-17	9/13/1999	1448	0.007	0.39	0.136	0.06	0.023	9	0.40	0.9	1.9	0.5	1.1
PD-18	10/18/1999	1030	0.009	0.02	0.068	0.05	0.003	13	0.07	0.3	0.3	4.0	0.5
PD-19	10/19/1999	1130	0.009	<0.02	0.040	<0.05	0.001	22	0.44	0.3	1.0	1.0	0.5
PD-20	10/19/1999	1545	0.007	0.02	0.043	<0.05	0.009	14	<0.05	<0.1	0.7	1.9	0.5
PD-20b	10/20/1999	800	0.010	0.06	<0.001	<0.05	<0.001	3	0.07	0.4	0.1	<0.1	<0.1
PD-21	10/25/1999	920	0.010	0.03	<0.001	<0.05	0.006	11	0.05	<0.1	0.1	2.6	<0.1
PD-22	10/25/1999	1240	0.014	0.02	0.006	<0.05	<0.001	23	0.58	3.2	0.7	2.8	0.3
PD-23	10/25/1999	1722	0.009	0.75	0.111	0.09	0.041	8	0.05	1.9	0.4	0.7	33.2
PD-24	10/26/1999	1324	0.008	0.04	0.077	0.05	0.001	6	0.09	1.5	0.3	3.3	1.0
PD-25	6/27/2000	1035	0.009	0.02	0.047	<0.05	0.002	14	0.13	1.1	0.9	2.7	3.7
PD-26	6/27/2000	1500	0.010	0.02	0.007	<0.05	0.007	9	0.19	1.4	1.7	2.4	4.7
PD-27	6/28/2000	920	0.009	0.06	0.052	0.12	0.035	15	0.16	1.4	0.6	0.1	9.4
PD-28	6/28/2000	1440	0.007	0.02	<0.001	<0.05	0.017	37	0.07	0.7	1.0	2.5	0.2
PD-29	6/29/2000	1130	0.007	0.02	0.013	<0.05	0.002	5	<0.05	1.1	0.8	2.0	0.3
PD-30	6/29/2000	1540	0.026	0.03	0.072	<0.05	0.022	200	0.34	39.1	2.3	1.3	0.2
VB-01	5/13/1999	1615	nd	nd	nd	0.05	nd	nd	nd	nd	nd	nd	nd
VB-02	5/14/1999	1115	nd	nd	nd	0.07	nd	nd	nd	nd	nd	nd	nd
VB-03	5/10/1999	1830	nd	nd	nd	0.26	nd	nd	nd	nd	nd	nd	nd
VB-04	5/12/1999	1230	nd	nd	nd	0.03	nd	nd	nd	nd	nd	nd	nd
VB-05	8/14/2000	1415	nd	nd	nd	1.03	nd	nd	nd	nd	nd	nd	nd
VB-05b	8/14/2000	1410	nd	nd	nd	0.01	nd	nd	nd	nd	nd	nd	nd
VB-06	8/11/2000	1000	nd	nd	nd	0.10	nd	nd	nd	nd	nd	nd	nd
VB-07	8/10/2000	1110	nd	nd	nd	12.50	nd	nd	nd	nd	nd	nd	nd
VB-08	8/9/2000	1130	nd	nd	nd	2.43	nd	nd	nd	nd	nd	nd	nd
VB-09	8/16/2000	1520	nd	nd	nd	2.31	nd	nd	nd	nd	nd	nd	nd
VB-10	8/17/2000	1045	nd	nd	nd	0.03	nd	nd	nd	nd	nd	nd	nd
VB-11	8/16/2000	945	nd	nd	nd	8.17	nd	nd	nd	nd	nd	nd	nd
VB-12	8/15/2000	1115	nd	nd	nd	0.05	nd	nd	nd	nd	nd	nd	nd
VB-13	8/8/2000	1225	nd	nd	nd	0.21	nd	nd	nd	nd	nd	nd	nd
VB-14	8/7/2000	1745	nd	nd	nd	0.04	nd	nd	nd	nd	nd	nd	nd
VB-14d	8/7/2000	1750	nd	nd	nd	0.05	nd	nd	nd	nd	nd	nd	nd
VR-01	7/6/1999	1230	0.006	<0.02	0.026	<0.05	0.008	12	0.36	0.4	<0.1	4.3	0.3
VR-02	7/6/1999	1615	0.006	<0.02	0.039	<0.05	0.009	16	0.10	3.2	0.1	3.7	0.3
VR-03	7/7/1999	1035	0.007	<0.02	0.024	<0.05	0.001	5	0.09	0.5	<0.1	1.5	0.2
VR-03d	7/7/1999	1040	0.007	<0.02	0.024	<0.05	0.001	2	0.08	0.4	<0.1	1.5	0.2

Table 7. Summary of trace-element chemistry[1] in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Al, aluminum; B, boron; Ba, barium; Br, bromide; Li, lithium; Zn, zinc; Pb, lead; Cu, copper; Ni, nickel; Rb, rubidium; V, vanadium; mg/L, milligrams per liter; mg/L, micrograms per liter; <, actual value is known to be less than value shown; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Al (mg/L)	B (mg/L)	Ba (mg/L)	Br (mg/L)	Li (mg/L)	Zn (μg/L)	Pb (μg/L)	Cu (μg/L)	Ni (μg/L)	Rb (μg/L)	V (μg/L)
VR-04	7/7/1999	1400	0.007	<0.02	0.026	<0.05	0.006	1	<0.05	0.4	<0.1	2.7	0.3
VR-05	7/8/1999	1015	0.007	0.02	0.041	<0.05	0.003	10	0.08	0.5	<0.1	1.5	0.3
VR-06	7/8/1999	1620	0.006	<0.02	0.041	<0.05	0.003	9	0.77	2.6	<0.1	2.8	0.3
VR-07	7/8/1999	1820	0.006	<0.02	0.039	<0.05	0.004	7	0.08	2.5	<0.1	3.0	0.3
VR-08	7/9/1999	1015	0.006	<0.02	0.041	<0.05	0.007	14	0.13	0.6	<0.1	4.2	0.3
VR-09	7/9/1999	1300	0.006	<0.02	0.041	<0.05	0.010	30	1.32	2.5	<0.1	4.0	0.4
VR-10	7/9/1999	1500	0.006	<0.02	0.047	<0.05	0.005	5	0.09	0.9	<0.1	3.5	0.3
VR-11	7/9/1999	1645	0.005	<0.02	0.009	<0.05	0.006	8	0.10	0.4	<0.1	3.5	0.6
VR-12	7/21/1999	945	0.006	<0.02	0.017	<0.05	<0.001	23	0.07	0.5	<0.1	0.7	0.6
VR-13	7/21/1999	1250	0.005	0.02	0.028	<0.05	0.003	38	0.47	1.6	0.1	0.9	0.4
VR-14	7/22/1999	1200	0.007	<0.02	0.028	<0.05	<0.001	1	<0.05	<0.1	<0.1	2.6	0.3
VR-15	8/10/1999	1400	0.006	0.21	0.051	<0.05	0.068	2	<0.01	0.2	0.5	0.7	0.1
VR-15bt	8/10/1999	1405	0.004	<0.02	<0.001	<0.05	<0.001	2	0.26	2.1	<0.1	<0.1	<0.1
VR-16	8/11/1999	1330	0.005	0.06	0.223	0.74	0.020	28	0.15	<0.1	0.5	1.2	0.4
VR-17	8/11/1999	1630	0.004	0.02	0.101	<0.05	0.007	10	0.19	0.4	0.3	1.5	0.8
VR-18	8/12/1999	1130	0.006	0.04	0.069	<0.05	0.022	5	0.05	0.2	<0.1	1.4	0.6
VR-19	8/24/1999	1050	0.009	0.02	0.007	<0.05	<0.001	4	<0.05	0.9	0.8	1.9	0.5
VR-20	8/24/1999	1315	0.007	<0.02	0.018	<0.05	<0.001	5	0.40	1.5	2.1	0.6	1.0
VR-21	8/25/1999	1530	0.007	0.02	0.134	<0.05	0.003	6	0.08	0.7	1.1	1.7	0.7
VR-22	8/26/1999	925	0.007	0.02	0.044	<0.05	0.002	38	0.10	0.6	3.0	1.1	0.5
VR-23	8/26/1999	1400	0.008	0.03	0.022	0.08	0.017	15	<0.05	1.1	3.8	5.1	0.4
VR-24	10/27/1999	925	0.008	0.05	0.274	<0.05	0.023	13	0.10	0.1	0.2	0.7	0.2
VR-25	10/27/1999	1340	0.008	0.11	0.069	<0.05	0.118	1	<0.05	0.2	0.3	0.9	0.5
VR-26	10/28/1999	1010	0.010	0.02	0.034	<0.05	0.003	<1	0.09	0.4	0.1	1.2	0.3
VR-27	10/28/1999	1345	0.011	0.03	0.059	<0.05	0.006	28	0.05	0.6	1.5	0.6	0.4
VR-28	7/12/2000	1415	0.008	0.03	0.488	<0.05	0.004	17	0.07	0.4	0.6	1.7	0.2
VR-29	7/13/2000	1108	<0.001	0.02	0.489	<0.05	0.027	29	<0.05	0.5	0.2	0.9	0.3
VR-30	7/13/2000	1415	0.007	0.15	0.093	0.08	0.059	40	<0.05	0.1	0.3	2.6	0.3
VR-31	7/17/2000	950	0.010	0.20	2.373	0.09	0.082	62	0.07	0.5	0.7	1.3	0.5
VR-32	7/17/2000	1321	0.006	0.03	0.239	<0.05	0.017	11	0.10	1.0	1.4	1.9	0.4
VR-33	7/18/2000	1030	0.007	0.02	0.058	<0.05	<0.001	57	0.11	3.2	1.5	0.6	0.6
VR-34	7/18/2000	1400	0.007	0.11	0.108	<0.05	0.032	5	0.14	0.1	0.2	0.7	0.3
VR-35	7/19/2000	915	<0.001	0.02	0.080	<0.05	0.017	144	<0.05	2.0	3.1	2.7	0.3
VR-35b	7/19/2000	1000	<0.001	<0.02	<0.001	<0.05	<0.001	3	<0.05	1.0	<0.1	<0.1	<0.1
VR-36	7/20/2000	1430	<0.001	<0.02	0.050	<0.05	<0.001	256	<0.05	0.8	2.4	0.7	0.5
VR-37	7/17/2000	950	<0.001	<0.02	0.037	<0.05	0.003	14	0.55	0.2	0.7	1.2	0.3
VR-37d	7/17/2000	955	<0.001	<0.02	0.037	<0.05	0.003	14	0.60	0.2	0.7	1.2	0.3
VR-38	7/18/2000	915	<0.001	<0.02	0.082	<0.05	<0.001	149	0.19	0.5	0.8	1.2	<0.1
VR-39	7/18/2000	1330	<0.001	<0.02	0.004	<0.05	0.004	16	0.06	0.4	0.6	2.1	0.8
VR-40	7/19/2000	925	<0.001	<0.02	0.195	<0.05	0.016	10	<0.05	0.3	0.1	1.6	0.6
VR-41	7/19/2000	1125	0.001	<0.02	0.259	<0.05	0.015	15	0.05	0.5	0.2	1.4	0.6
VR-42	7/20/2000	1200	<0.001	<0.02	0.012	<0.05	0.001	131	0.12	0.3	0.2	0.6	0.3
VR-42bt	7/20/2000	1205	0.004	<0.02	<0.001	<0.05	<0.001	3	0.13	0.4	<0.1	<0.1	<1
VR-43	7/20/2000	1740	<0.001	<0.02	0.057	<0.05	0.011	65	0.11	<0.1	0.8	1.2	0.2

Table 7. Summary of trace-element chemistry[1] in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Al, aluminum; B, boron; Ba, barium; Br, bromide; Li, lithium; Zn, zinc; Pb, lead; Cu, copper; Ni, nickel; Rb, rubidium; V, vanadium; mg/L, milligrams per liter; mg/L, micrograms per liter; <, actual value is known to be less than value shown; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Al (mg/L)	B (mg/L)	Ba (mg/L)	Br (mg/L)	Li (mg/L)	Zn (μg/L)	Pb (μg/L)	Cu (μg/L)	Ni (μg/L)	Rb (μg/L)	V (μg/L)
VR-44	7/20/2000	900	<0.001	<0.02	0.016	<0.05	0.002	10	0.06	0.3	<0.1	0.6	0.2
VR-45	7/25/2000	920	0.001	<0.02	0.022	<0.05	0.005	8	0.10	0.6	<0.1	3.9	0.5
VR-46	7/25/2000	1310	0.001	0.03	0.520	<0.05	0.010	58	0.59	2.6	0.4	0.7	0.5
VR-47	7/26/2000	1015	0.002	<0.02	0.023	<0.05	0.001	8	0.22	0.9	0.3	1.5	0.4
VTDW-01	9/16/1999	1505	0.011	0.02	0.014	<0.05	0.001	8	<0.05	3.6	4.6	6.2	<0.1
VTDW-03A	7/15/2000	1300	0.009	<0.02	0.028	<0.05	0.001	5	0.29	3.1	0.4	9.8	0.2
VTDW-03B	7/15/2000	1700	0.009	<0.02	0.030	<0.05	0.001	6	0.33	2.1	0.8	9.4	0.3
VTDW-07A	7/14/2000	1430	0.009	<0.02	0.055	<0.05	0.002	5	<0.05	0.2	0.6	7.7	0.8
VTDW-07B	7/14/2000	1610	0.012	<0.02	0.067	<0.05	0.002	17	0.60	3.0	1.6	6.7	0.5
VTDW-08	9/16/1999	1800	0.010	0.02	0.034	<0.05	0.001	5	<0.05	5.2	1.0	0.6	0.8

[1] Water samples collected by the Virginia Aquifer Susceptibility and Virginia Polytechnic Institute and State University Fractured Rock Hydrology studies for the determination of trace-element chemistry were analyzed at the U.S. Geological Survey National Research Program Common Use Laboratory, Reston, Va. Water samples collected by the Virginia Beach Shallow Ground Water study for the determination of trace-element chemistry were analyzed at the U.S. Geological Survey National Water-Quality Laboratory, Denver, Colo.

Table 8. Summary of averaged dissolved gas compositions (nitrogen, argon, oxygen, carbon dioxide, methane, helium, and neon), recharge temperatures, and quantities of excess air in water samples from wells and springs in Virginia, 1998-2000

[VAS, Virginia Aquifer Susceptibility study; Rech. Elev., recharge elevation is land surface; ft, feet; n_{dg}, number of dissolved gas samples averaged; N_2, nitrogen; Ar, argon; O_2, oxygen; CO_2, carbon dioxide; CH_4, methane; mg/L, milligrams per liter; Rech. temp., recharge temperature; ºC, degrees Celsius; Ex. air, excess air; cc_{STP}/L, cubic centimeters at standard temperature and pressure per liter; $n_{He\text{-}Negc}$, number of helium and neon gas samples averaged from the gas chromatography procedure; n_{Ne}, number of neon gas samples averaged from the mass-spectrometric procedure; cc_{STP}/g, cubic centimeters at standard temperature and pressure per gram; nd, not determined; Recharge temperatures in italics were estimated from local mean annual air temperatures, not from dissolved gas data and quantities of excess air were assumed to be zero. See figure 1 for location of wells and springs.]

VAS no.	Date	Rech. Elev. (ft)	n_{dg}	N_2 (mg/L)[1]	Ar (mg/L)[1]	Field O_2 (mg/L)	Lab O_2 (mg/L)[1]	CO_2 (mg/L)[1]	CH_4 (mg/L)[1]	N_2-Ar Rech. temp. (ºC)	N_2-Ar Ex. air (cc_{STP}/L)	$n_{He\text{-}Negc}$	Helium x10^{-8} (cc_{STP}/g)[2]	Neon x10^{-8} (cc_{STP}/g)[2]	n_{Ne}	Neon x10^{-8} (cc_{STP}/g)[3]	Neon Ex. air (cc_{STP}/L)[4]
AP-01	7/10/2000	1,130	2	12.11	0.4477	nd	0.1	8.4	28.7809	*13.0*	*0.0*	1	282.438	nd	0	nd	nd
AP-02	7/10/2000	1,440	2	20.79	0.7123	nd	0.1	31.3	0.7754	10.1	3.6	1	22.128	90.557	1	25.089	3.3
AP-03	7/20/2000	1,735	2	19.51	0.6555	3.0	1.0	18.1	0.0000	13.8	3.8	1	49.256	11.906	0	nd	nd
AP-03d	7/20/2000	1,735	2	19.50	0.6530	3.0	1.3	17.7	0.0000	14.1	3.9	0	nd	nd	0	nd	nd
AP-04	7/11/2000	1,840	2	15.06	0.5900	0.4	0.1	7.9	4.0879	12.3	-1.2	1	61.904	nd	0	nd	nd
AP-05	7/12/2000	1,940	2	15.06	0.5667	0.6	0.0	36.8	15.7284	15.2	-0.2	1	22.036	nd	0	nd	nd
AP-06	7/13/2000	2,340	2	18.95	0.6710	0.4	0.1	31.6	0.0779	9.8	2.2	0	nd	nd	0	nd	nd
AP-07	7/13/2000	2,780	1	18.36	0.6351	0.7	0.1	31.7	2.6332	12.3	2.8	1	8.921	20.014	1	18.784	0.5
AP-08	7/10/2000	2,710	1	21.19	0.6902	3.4	0.4	5.1	0.0006	11.6	5.4	1	216.954	nd	0	nd	nd
AP-09	7/10/2000	1,735	2	21.30	0.6873	1.2	0.1	57.3	1.2093	13.7	5.6	1	34.967	nd	0	nd	nd
AP-10	7/11/2000	1,560	2	12.82	0.4817	1.2	0.1	22.8	20.9864	*12.0*	*0.0*	1	604.419	nd	0	nd	nd
AP-11	7/11/2000	1,755	2	11.23	0.4466	3.8	0.0	20.2	18.2859	*12.0*	*0.0*	1	172.303	nd	0	nd	nd
AP-12	7/12/2000	1,660	2	15.65	0.5915	3.1	0.0	3.5	8.3735	13.7	-0.2	1	515.957	nd	0	nd	nd
AP-13	7/12/2000	1,670	2	20.40	0.7081	0.6	0.1	12.1	0.1479	9.4	3.2	1	71.207	nd	0	nd	nd
BR-01	7/19/1999	750	1	22.73	0.6744	0.5	0.1	9.2	0.0000	*13.5*	*0.0*	1	11.992	24.390	0	nd	nd
BR-02	7/19/1999	690	1	20.82	0.6977	8.7	9.6	25.3	0.0000	13.0	4.2	2	7.330	30.407	0	nd	nd
BR-03	7/20/1999	3,440	1	17.36	0.6353	9.6	8.1	19.7	0.0000	9.2	1.1	2	6.657	25.934	1	19.606	0.9
BR-04	7/20/1999	1,290	1	22.40	0.7370	0.7	0.1	20.3	0.0098	10.6	5.4	1	10.186	36.893	0	nd	nd
BR-05	8/25/1999	1,040	1	24.01	0.7744	7.8	7.1	6.5	0.0000	9.8	6.6	1	7.383	38.574	1	30.330	6.0
BR-06	9/13/1999	660	1	19.51	0.6948	4.3	3.2	40.6	0.0026	10.7	2.1	2	5.396	22.000	1	20.804	0.7
BR-07	9/14/1999	490	2	23.65	0.6975	0.3	0.2	21.7	0.0018	19.9	9.2	1	9.906	23.236	0	nd	nd
BR-08	9/16/1999	2,450	1	16.19	0.5973	6.7	5.0	73.0	0.0000	12.9	0.6	1	5.554	25.398	1	18.167	0.1
BR-09	10/18/1999	940	2	25.67	0.7899	0.6	0.1	72.1	0.0097	11.5	8.8	1	11.774	32.513	0	nd	nd
BR-10	10/26/1999	500	2	25.74	0.6807	1.3	0.4	59.0	0.1451	*13.1*	*0.0*	1	13.062	59.482	0	nd	nd
CP-01	6/23/1998	350	2	20.86	0.7372	0.7	0.2	6.1	0.0107	9.1	2.6	2	251.068	nd	0	nd	nd
CP-01d	6/23/1998	350	2	20.94	0.7392	0.7	0.1	6.2	0.0106	9.0	2.6	0	nd	nd	0	nd	nd

Table 8. Summary of averaged dissolved gas compositions (nitrogen, argon, oxygen, carbon dioxide, methane, helium, and neon), recharge temperatures, and quantities of excess air in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Rech. Elev., recharge elevation is land surface; ft, feet; n_{dg}, number of dissolved gas samples averaged; N_2, nitrogen; Ar, argon; O_2, oxygen; CO_2, carbon dioxide; CH_4, methane; mg/L, milligrams per liter; Rech. temp., recharge temperature; °C, degrees Celsius; Ex. air, excess air; cc_{STP}/L, cubic centimeters at standard temperature and pressure per liter; $n_{He\text{-}Negc}$, number of helium and neon gas samples averaged from the gas chromatography procedure; n_{Ne}, number of neon gas samples averaged from the mass-spectrometric procedure; cc_{STP}/g, cubic centimeters at standard temperature and pressure per gram; nd, not determined; Recharge temperatures in italics were estimated from local mean annual air temperatures, not from dissolved gas data and quantities of excess air were assumed to be zero. See figure 1 for location of wells and springs.]

VAS no.	Date	Rech. Elev. (ft)	n_{dg}	N_2 (mg/L)[1]	Ar (mg/L)[1]	Field O_2 (mg/L)	Lab O_2 (mg/L)[1]	CO_2 (mg/L)[1]	CH_4 (mg/L)[1]	N_2-Ar Rech. temp. (°C)	N_2-Ar Ex. air (cc_{STP}/L)	$n_{He\text{-}Negc}$	Helium $x10^{-8}$ (cc_{STP}/g)[2]	Neon $x10^{-8}$ (cc_{STP}/g)[2]	n_{Ne}	Neon $x10^{-8}$ (cc_{STP}/g)[3]	Neon Ex. air (cc_{STP}/L)[4]
CP-02	6/24/1998	200	2	20.12	0.6910	0.2	0.2	1.2	0.0051	13.1	3.3	1	77.222	9.760	0	nd	nd
CP-03	6/25/1998	350	2	21.20	0.7376	0.1	0.2	6.5	0.0070	9.7	3.2	1	301.238	nd	0	nd	nd
CP-04	7/1/1998	350	2	22.75	0.8098	0.2	0.1	1.6	0.0064	5.2	2.8	1	100.296	nd	0	nd	nd
CP-05	7/6/1998	250	1	23.40	0.8202	0.1	0.2	1.2	0.1166	5.4	3.5	1	72.616	nd	0	nd	nd
CP-06	7/6/1998	250	2	21.77	0.7593	0.1	0.1	2.7	0.0076	8.6	3.2	2	441.667	nd	0	nd	nd
CP-07	7/7/1998	250	2	23.24	0.8263	0.3	0.1	2.3	0.0211	4.6	2.9	1	46.452	23.777	0	nd	nd
CP-08	7/7/1998	250	2	22.54	0.7993	0.1	0.1	2.0	0.0066	6.0	2.9	1	81.430	16.042	0	nd	nd
CP-09	7/8/1998	100	2	22.05	0.7464	0.1	0.1	22.4	0.0306	10.7	4.3	1	165.366	nd	0	nd	nd
CP-10	7/8/1998	250	2	21.88	0.7655	0.2	0.1	1.8	0.0710	8.1	3.2	1	273.196	nd	0	nd	nd
CP-11	7/9/1998	100	3	21.07	0.7422	0.1	0.1	8.9	0.0098	9.3	2.7	2	32.632	26.443	0	nd	nd
CP-11b	7/9/1998	100	1	21.14	0.7462	0.1	0.1	9.1	0.0093	9.0	2.7	0	nd	nd	0	nd	nd
CP-12	7/14/1998	50	2	20.32	0.6988	0.2	0.2	0.7	0.2844	12.8	3.2	1	7.660	28.016	2	24.494	2.7
CP-13	7/15/1998	50	2	21.58	0.7569	0.1	0.1	3.9	0.0474	8.8	3.0	1	40.345	27.574	0	nd	nd
CP-14	7/15/1998	50	2	18.27	0.6347	5.5	1.9	65.4	0.0000	16.5	2.4	1	6.023	23.734	1	22.951	2.2
CP-15	7/15/1998	50	2	21.62	0.7609	0.2	0.1	5.3	0.0252	8.4	2.9	1	59.648	21.202	0	nd	nd
CP-16	7/16/1998	50	1	20.55	0.7235	0.1	1.4	2.9	2.1736	10.4	2.6	1	9.915	27.164	2	25.294	2.9
CP-17	7/16/1998	50	1	19.47	0.6876	0.1	2.6	4.0	4.3128	12.4	2.3	1	20.616	22.539	0	nd	nd
CP-18	7/27/1998	250	2	20.33	0.7189	0.8	0.1	8.8	0.0007	10.2	2.4	1	7.028	28.454	2	24.645	2.5
CP-19	7/27/1998	250	2	19.96	0.7000	0.1	0.1	11.8	0.0037	11.6	2.6	1	7.903	25.913	2	24.688	2.7
CP-20	7/28/1998	350	2	21.88	0.7621	0.1	0.1	4.9	0.0064	8.3	3.3	1	372.587	nd	0	nd	nd
CP-21	7/29/1998	50	2	21.14	0.6960	0.1	0.2	30.0	0.2167	14.9	4.8	1	9.247	27.610	2	26.007	3.7
CP-22	7/30/1998	250	2	20.15	0.7031	0.1	0.1	10.9	0.0046	11.7	2.8	1	40.010	17.549	0	nd	nd
CP-23	8/3/1998	200	2	22.15	0.7823	0.2	0.1	1.9	0.0956	7.0	2.9	2	11.822	26.017	0	nd	nd
CP-23d	8/3/1998	200	2	22.15	0.7850	0.2	0.1	1.9	0.0919	6.7	2.8	0	nd	nd	0	nd	nd
CP-24	8/4/1998	300	1	21.18	0.7410	0.1	0.1	2.5	0.0089	9.3	3.0	1	533.205	nd	0	nd	nd
CP-25	8/4/1998	300	1	20.46	0.7237	0.2	0.1	1.1	0.0077	9.9	2.5	2	93.983	nd	0	nd	nd

Table 8. Summary of averaged dissolved gas compositions (nitrogen, argon, oxygen, carbon dioxide, methane, helium, and neon), recharge temperatures, and quantities of excess air in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Rech. Elev., recharge elevation is land surface; ft, feet; n_{dg}, number of dissolved gas samples averaged; N_2, nitrogen; Ar, argon; O_2, oxygen; CO_2, carbon dioxide; CH_4, methane; mg/L, milligrams per liter; Rech. temp., recharge temperature; °C, degrees Celsius; Ex. air, excess air; cc_{STP}/L, cubic centimeters at standard temperature and pressure per liter; $n_{He\text{-}Negc}$, number of helium and neon gas samples averaged from the gas chromatography procedure; n_{Ne}, number of neon gas samples averaged from the mass-spectrometric procedure; cc_{STP}/g, cubic centimeters at standard temperature and pressure per gram; nd, not determined; Recharge temperatures in italics were estimated from local mean annual air temperatures, not from dissolved gas data and quantities of excess air were assumed to be zero. See figure 1 for location of wells and springs.]

VAS no.	Date	Rech. Elev. (ft)	n_{dg}	N_2 (mg/L)[1]	Ar (mg/L)[1]	Field O_2 (mg/L)	Lab O_2 (mg/L)[1]	CO_2 (mg/L)[1]	CH_4 (mg/L)[1]	N_2-Ar Rech. temp. (°C)	N_2-Ar Ex. air (cc_{STP}/L)	$n_{He\text{-}Negc}$	Helium x10^{-8} (cc_{STP}/g)[2]	Neon x10^{-8} (cc_{STP}/g)[2]	n_{Ne}	Neon x10^{-8} (cc_{STP}/g)[3]	Neon Ex. air (cc_{STP}/L)[4]
CP-26	8/5/1998	100	2	18.83	0.6681	6.9	7.1	27.6	0.0000	13.3	2.0	1	5.816	22.766	2	23.888	2.4
CP-27	8/6/1998	350	2	20.81	0.7385	0.1	0.1	7.5	0.0409	8.9	2.5	1	1315.799	nd	0	nd	nd
CP-28	8/17/1998	250	2	25.00	0.8024	0.1	0.2	7.4	0.1032	9.8	7.1	1	147.949	nd	0	nd	nd
CP-29	8/17/1998	250	2	21.81	0.7701	0.1	0.1	1.5	0.0169	7.6	2.8	1	97.705	nd	0	nd	nd
CP-30	8/18/1998	250	2	22.95	0.8314	0.3	0.1	3.5	0.0074	3.8	2.2	1	37.063	17.630	0	nd	nd
CP-31	8/19/1998	250	2	21.21	0.7657	0.1	0.1	2.0	0.0004	7.0	2.0	1	130.627	nd	0	nd	nd
CP-32	8/31/1998	250	2	23.93	0.8321	0.1	0.4	2.2	0.0054	5.1	3.9	1	10.992	20.625	0	nd	nd
CP-33	8/31/1998	250	2	20.63	0.7296	0.2	0.1	33.2	0.0044	9.6	2.5	1	85.682	nd	0	nd	nd
CP-34	8/31/1998	200	1	22.22	0.7113	0.1	0.1	61.6	0.0282	15.0	6.1	2	18.945	25.582	0	nd	nd
CP-34d	8/31/1998	200	2	22.15	0.7068	0.1	0.1	61.8	0.0278	15.5	6.1	0	nd	nd	0	nd	nd
CP-35	9/1/1998	250	2	21.06	0.7574	0.3	0.1	3.7	0.0490	7.5	2.1	1	2402.277	nd	0	nd	nd
CP-36	9/1/1998	250	2	21.54	0.7713	0.2	0.1	2.3	0.0040	7.0	2.3	1	101.111	nd	0	nd	nd
CP-37	9/2/1998	250	2	22.23	0.7883	0.2	0.1	6.6	0.0085	6.5	2.8	1	73.463	nd	0	nd	nd
CP-38	9/2/1998	250	2	23.20	0.8191	0.2	0.1	4.0	0.0047	5.2	3.2	1	79.886	nd	0	nd	nd
CP-39	9/2/1998	250	2	20.75	0.7365	0.2	0.1	7.4	0.0372	9.1	2.4	1	314.804	nd	0	nd	nd
CP-40	9/3/1998	250	2	22.67	0.8018	0.2	0.1	1.8	0.0066	6.0	3.0	1	106.352	nd	0	nd	nd
CP-41	9/10/1998	250	2	22.03	0.7791	0.1	0.2	2.5	0.0059	7.1	2.8	1	108.321	nd	0	nd	nd
CP-42	9/10/1998	250	2	21.79	0.7731	0.1	0.1	1.4	0.0098	7.2	2.7	1	2022.551	nd	0	nd	nd
CP-43	10/1/1998	150	2	22.78	0.8054	0.2	0.1	0.7	0.0254	5.9	3.0	1	110.260	nd	0	nd	nd
CP-44	10/5/1998	150	2	22.63	0.7927	0.3	0.1	2.9	0.0091	6.9	3.3	1	433.019	nd	0	nd	nd
CP-45	10/5/1998	50	2	20.76	0.7037	0.2	0.1	4.9	0.0175	13.1	3.8	1	5.599	19.994	0	nd	nd
CP-46	10/6/1998	150	2	19.54	0.6804	6.4	6.6	44.6	0.0000	13.2	2.7	1	6.862	20.942	2	25.511	3.3
CP-47	10/6/1998	250	2	21.19	0.7545	0.3	0.1	2.5	0.0108	8.1	2.4	1	11.157	22.494	0	nd	nd
CP-48	10/7/1998	150	0	nd	nd	7.1	nd	nd	nd	*13.2*	*0.0*	1	15.856	57.147	0	nd	nd
CP-49	10/27/1998	100	2	19.03	0.6887	0.3	0.1	8.5	0.0023	11.3	1.4	1	9.270	23.537	2	23.115	1.8
CP-50	10/28/1998	200	2	17.00	0.6361	3.9	6.5	63.7	0.0000	13.3	0.1	1	6.084	22.043	1	19.661	0.1

Table 8. Summary of averaged dissolved gas compositions (nitrogen, argon, oxygen, carbon dioxide, methane, helium, and neon), recharge temperatures, and quantities of excess air in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Rech. Elev., recharge elevation is land surface; ft, feet; n_{dg}, number of dissolved gas samples averaged; N_2, nitrogen; Ar, argon; O_2, oxygen; CO_2, carbon dioxide; CH_4, methane; mg/L, milligrams per liter; Rech. temp., recharge temperature; °C, degrees Celsius; Ex. air, excess air; cc_{STP}/L, cubic centimeters at standard temperature and pressure per liter; $n_{He\text{-}Negc}$, number of helium and neon gas samples averaged from the gas chromatography procedure; n_{Ne}, number of neon gas samples averaged from the mass-spectrometric procedure; cc_{STP}/g, cubic centimeters at standard temperature and pressure per gram; nd, not determined; Recharge temperatures in italics were estimated from local mean annual air temperatures, not from dissolved gas data and quantities of excess air were assumed to be zero. See figure 1 for location of wells and springs.]

VAS no.	Date	Rech. Elev. (ft)	n_{dg}	N_2 (mg/L)[1]	Ar (mg/L)[1]	Field O_2 (mg/L)	Lab O_2 (mg/L)[1]	CO_2 (mg/L)[1]	CH_4 (mg/L)[1]	N_2-Ar Rech. temp. (°C)	N_2-Ar Ex. air (cc_{STP}/L)	$n_{He\text{-}Negc}$	Helium $x10^{-8}$ (cc_{STP}/g)[2]	Neon $x10^{-8}$ (cc_{STP}/g)[2]	n_{Ne}	Neon $x10^{-8}$ (cc_{STP}/g)[3]	Neon Ex. air (cc_{STP}/L)[4]
CP-51	11/4/1998	250	2	20.79	0.7402	0.2	0.1	19.5	0.0031	8.8	2.3	2	2528.689	nd	0	nd	nd
CP-51d	11/4/1998	250	2	20.80	0.7390	0.2	0.1	19.4	0.0031	9.0	2.4	0	nd	nd	0	nd	nd
PD-01	6/28/1999	362	1	21.68	0.7423	0.3	0.1	1.0	0.0000	10.0	3.8	1	57.363	34.866	1	26.849	3.8
PD-02	6/29/1999	775	1	19.55	0.6749	0.3	0.1	23.2	0.0053	13.0	3.0	1	108.615	nd	2	23.327	2.3
PD-03	6/30/1999	558	1	19.98	0.6716	1.8	0.4	13.4	0.0000	14.6	3.9	1	6.652	26.792	1	23.552	2.5
PD-04	6/30/1999	860	1	20.18	0.6855	0.8	0.2	2.7	0.0000	12.9	3.7	2	8.684	28.059	1	23.639	2.5
PD-05	7/1/1999	500	2	21.93	0.7090	0.3	0.1	60.1	0.0355	14.2	5.7	1	10.765	32.158	1	26.478	4.1
PD-06	8/23/1999	355	2	27.27	0.8712	4.2	2.0	18.2	0.0000	6.6	8.1	1	4.494	nd	1	35.444	8.2
PD-07	8/23/1999	415	1	24.71	0.7754	2.5	0.1	33.3	0.0001	12.0	7.7	2	8.598	31.966	1	30.668	6.1
PD-08	8/30/1999	480	2	17.37	0.6375	7.8	6.7	30.4	0.0000	13.5	0.7	1	10.966	nd	0	nd	nd
PD-09	8/31/1999	120	1	21.32	0.7403	1.5	0.2	11.9	0.0000	9.9	3.2	1	352.130	nd	0	nd	nd
PD-10	9/1/1999	535	1	18.47	0.6443	7.3	5.5	78.6	0.0000	14.9	2.4	2	7.128	23.295	1	21.952	1.7
PD-11	9/1/1999	555	1	20.27	0.6791	5.6	4.2	73.6	0.0000	14.3	4.0	2	8.015	28.261	1	24.679	3.1
PD-12	9/1/1999	220	1	19.66	0.6776	0.5	0.1	38.4	0.0107	13.7	3.0	1	654.859	nd	0	nd	nd
PD-13	9/2/1999	360	1	19.87	0.7005	8.0	6.6	56.9	0.0000	11.2	2.4	1	8.319	nd	1	23.517	2.1
PD-14	9/2/1999	430	2	20.95	0.7177	7.0	5.1	62.0	0.0000	11.3	3.6	1	4.798	22.422	1	24.943	2.9
PD-15	9/2/1999	350	1	19.84	0.6760	0.6	0.1	23.9	0.0011	14.1	3.4	3	8.954	26.020	1	22.760	2.0
PD-15d	9/2/1999	350	1	19.65	0.6730	0.6	0.1	23.6	0.0010	14.1	3.2	0	nd	nd	1	22.562	1.9
PD-16	9/13/1999	290	1	24.13	0.7929	0.8	0.5	16.0	0.0000	9.2	5.9	1	293.210	nd	0	nd	nd
PD-17	9/13/1999	325	2	23.49	0.7799	0.3	0.1	4.4	0.0011	9.4	5.4	0	nd	nd	0	nd	nd
PD-18	10/18/1999	315	1	23.67	0.7637	1.1	0.1	12.9	0.0016	11.5	6.4	1	63.127	nd	0	nd	nd
PD-19	10/19/1999	400	2	20.65	0.7187	3.9	2.2	5.5	0.0000	10.6	3.0	1	6.804	24.424	1	25.084	2.9
PD-20	10/19/1999	390	1	24.48	0.7825	0.9	0.1	48.4	0.0025	10.8	7.0	2	9.031	49.532	1	29.057	5.1
PD-20b	10/20/1999	nd	0	nd	nd	nd	nd	nd	nd	nd	nd	0	nd	nd	0	nd	nd
PD-21	10/25/1999	295	1	19.20	0.6879	1.7	0.2	3.4	0.0000	11.5	1.8	1	10.976	26.985	0	nd	nd
PD-22	10/25/1999	425	1	18.28	0.6744	6.3	3.7	41.5	0.0000	11.0	0.8	2	11.419	25.841	0	nd	nd

Table 8. Summary of averaged dissolved gas compositions (nitrogen, argon, oxygen, carbon dioxide, methane, helium, and neon), recharge temperatures, and quantities of excess air in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Rech. Elev., recharge elevation is land surface; ft, feet; n_{dg}, number of dissolved gas samples averaged; N_2, nitrogen; Ar, argon; O_2, oxygen; CO_2, carbon dioxide; CH_4, methane; mg/L, milligrams per liter; Rech. temp., recharge temperature; °C, degrees Celsius; Ex. air, excess air; cc_{STP}/L, cubic centimeters at standard temperature and pressure per liter; $n_{He\text{-}Negc}$, number of helium and neon gas samples averaged from the gas chromatography procedure; n_{Ne}, number of neon gas samples averaged from the mass-spectrometric procedure; cc_{STP}/g, cubic centimeters at standard temperature and pressure per gram; nd, not determined; Recharge temperatures in italics were estimated from local mean annual air temperatures, not from dissolved gas data and quantities of excess air were assumed to be zero. See figure 1 for location of wells and springs.]

VAS no.	Date	Rech. Elev. (ft)	n_{dg}	N_2 (mg/L)[1]	Ar (mg/L)[1]	Field O_2 (mg/L)	Lab O_2 (mg/L)[1]	CO_2 (mg/L)[1]	CH_4 (mg/L)[1]	N_2-Ar Rech. temp. (°C)	N_2-Ar Ex. air (cc_{STP}/L)	$n_{He\text{-}Negc}$	Helium $\times10^{-8}$ (cc_{STP}/g)[2]	Neon $\times10^{-8}$ (cc_{STP}/g)[2]	n_{Ne}	Neon $\times10^{-8}$ (cc_{STP}/g)[3]	Neon Ex. air (cc_{STP}/L)[4]
PD-23	10/25/1999	175	1	24.42	0.7984	3.5	0.9	18.1	0.0000	9.3	6.2	1	167.024	nd	0	nd	nd
PD-24	10/26/1999	345	1	20.23	0.7092	8.0	5.2	25.6	0.0000	11.0	2.7	2	6.524	25.939	0	nd	nd
PD-25	6/27/2000	1085	2	19.61	0.6798	5.5	2.4	33.2	0.0000	12.0	2.9	1	5.477	24.654	1	23.237	2.3
PD-26	6/27/2000	875	2	18.93	0.7001	5.0	1.5	22.2	0.0000	8.8	0.8	1	1.992	11.844	0	nd	nd
PD-27	6/28/2000	360	2	25.09	0.7997	1.6	0.3	5.7	0.0000	10.1	7.3	1	184.600	nd	0	nd	nd
PD-28	6/28/2000	318	1	19.65	0.6840	1.5	0.3	9.6	0.0000	12.8	2.7	1	8.274	28.483	0	nd	nd
PD-29	6/29/2000	335	2	21.36	0.6804	0.8	0.1	8.2	0.0000	17.0	5.9	1	7.361	29.561	1	22.853	2.3
PD-30	6/29/2000	258	2	23.34	0.7790	0.6	0.1	43.4	0.0000	9.3	5.1	1	7.010	33.320	1	29.130	5.0
VB-01	5/13/1999	10	1	20.48	0.7194	0.2	0.3	3.5	0.4504	10.8	2.7	1	19.035	35.170	0	nd	nd
VB-02	5/14/1999	10	1	21.01	0.6934	0.2	0.3	14.3	0.3479	15.0	4.7	1	7.211	41.019	0	nd	nd
VB-03	5/10/1999	10	1	21.94	0.7168	0.3	0.4	25.4	0.5084	14.0	5.3	1	7.547	40.273	0	nd	nd
VB-04	5/12/1999	10	1	20.19	0.6923	0.3	0.8	5.5	1.2813	13.4	3.3	1	9.185	44.212	0	nd	nd
VB-05	8/14/2000	10	2	20.86	0.7228	0.4	0.3	7.3	1.0934	11.2	3.2	1	118.367	nd	0	nd	nd
VB-05b	8/14/2000	nd	0	nd	nd	nd	nd	nd	nd	nd	nd	0	nd	nd	0	nd	nd
VB-06	8/11/2000	10	2	22.59	0.7606	0.4	0.1	32.4	0.3893	10.3	4.6	1	30.598	31.856	0	nd	nd
VB-07	8/10/2000	10	2	20.06	0.7055	0.5	0.0	70.0	0.0410	11.6	2.5	0	nd	nd	0	nd	nd
VB-08	8/9/2000	10	2	20.20	0.7059	0.1	0.1	39.1	21.7252	11.8	2.7	1	149.025	nd	0	nd	nd
VB-09	8/16/2000	10	2	20.27	0.7163	0.0	0.1	13.8	0.0055	10.8	2.4	1	136.851	nd	0	nd	nd
VB-10	8/17/2000	10	1	21.88	0.7531	0.2	0.1	14.7	0.6119	9.8	3.7	1	66.712	nd	0	nd	nd
VB-11	8/16/2000	10	2	19.98	0.7121	0.2	0.1	19.5	0.0173	10.7	2.1	1	285.887	nd	0	nd	nd
VB-12	8/15/2000	10	2	21.15	0.7340	0.2	0.1	5.9	0.2206	10.5	3.2	1	26.753	34.755	0	nd	nd
VB-13	8/8/2000	10	2	21.08	0.7325	0.1	0.1	10.0	0.0323	10.5	3.1	0	nd	nd	0	nd	nd
VB-14	8/7/2000	10	2	21.30	0.7414	0.1	0.1	9.6	1.3646	9.9	3.1	1	32.589	58.105	0	nd	nd
VB-14d	8/7/2000	10	2	21.39	0.7454	0.1	0.1	10.0	1.3709	9.7	3.1	1	21.278	nd	0	nd	nd
VR-01	7/6/1999	1,175	2	24.70	0.8033	7.7	8.3	3.9	0.0000	7.8	6.6	1	12.258	53.980	1	34.267	8.0
VR-02	7/6/1999	1,170	1	18.98	0.6875	7.4	5.9	10.4	0.0000	9.8	1.5	1	6.290	40.878	1	22.317	1.6

Table 8. Summary of averaged dissolved gas compositions (nitrogen, argon, oxygen, carbon dioxide, methane, helium, and neon), recharge temperatures, and quantities of excess air in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Rech. Elev., recharge elevation is land surface; ft, feet; n_{dg}, number of dissolved gas samples averaged; N_2, nitrogen; Ar, argon; O_2, oxygen; CO_2, carbon dioxide; CH_4, methane; mg/L, milligrams per liter; Rech. temp., recharge temperature; °C, degrees Celsius; Ex. air, excess air; cc_{STP}/L, cubic centimeters at standard temperature and pressure per liter; $n_{He\text{-}Negc}$, number of helium and neon gas samples averaged from the gas chromatography procedure; n_{Ne}, number of neon gas samples averaged from the mass-spectrometric procedure; cc_{STP}/g, cubic centimeters at standard temperature and pressure per gram; nd, not determined; Recharge temperatures in italics were estimated from local mean annual air temperatures, not from dissolved gas data and quantities of excess air were assumed to be zero. See figure 1 for location of wells and springs.]

VAS no.	Date	Rech. Elev. (ft)	n_{dg}	N_2 (mg/L)[1]	Ar (mg/L)[1]	Field O_2 (mg/L)	Lab O_2 (mg/L)[1]	CO_2 (mg/L)[1]	CH_4 (mg/L)[1]	N_2-Ar Rech. temp. (°C)	N_2-Ar Ex. air (cc_{STP}/L)	$n_{He\text{-}Negc}$	Helium $\times10^{-8}$ (cc_{STP}/g)[2]	Neon $\times10^{-8}$ (cc_{STP}/g)[2]	n_{Ne}	Neon $\times10^{-8}$ (cc_{STP}/g)[3]	Neon Ex. air (cc_{STP}/L)[4]
VR-03	7/7/1999	1,360	1	22.20	0.7417	6.9	6.1	1.7	0.0000	9.6	4.8	4	6.362	46.524	1	26.145	3.8
VR-03d	7/7/1999	1,360	1	21.03	0.7235	6.9	5.9	1.6	0.0000	9.4	3.6	0	nd	nd	1	26.175	3.8
VR-04	7/7/1999	1,320	2	22.09	0.7481	7.4	7.4	1.6	0.0000	8.7	4.4	1	9.098	30.425	0	nd	nd
VR-05	7/8/1999	725	2	17.78	0.6361	2.8	1.2	7.5	0.0000	14.1	1.5	1	7.175	28.328	1	20.442	0.8
VR-06	7/8/1999	1,080	2	24.73	0.7997	7.3	3.8	12.9	0.0002	8.4	6.8	1	5.783	31.729	1	32.833	7.2
VR-07	7/8/1999	1,070	1	23.31	0.7879	6.3	5.4	8.2	0.0000	7.2	4.8	2	7.559	42.559	1	29.891	5.5
VR-08	7/9/1999	1,050	2	19.67	0.7048	5.7	3.9	6.3	0.0000	9.4	2.0	1	19.648	nd	1	22.692	1.7
VR-09	7/9/1999	970	1	20.61	0.7200	7.0	5.9	4.4	0.0000	9.6	2.9	1	15.881	nd	1	24.764	2.9
VR-10	7/9/1999	1,070	1	19.06	0.6928	6.1	4.7	6.4	0.0000	9.5	1.4	2	10.239	36.102	1	22.639	1.7
VR-11	7/9/1999	1,140	1	21.93	0.7448	7.4	6.6	5.4	0.0000	9.1	4.2	1	7.294	30.530	1	28.290	4.8
VR-12	7/21/1999	1,590	1	20.24	0.6946	7.8	6.9	9.6	0.0000	10.8	3.4	2	10.327	44.653	0	nd	nd
VR-13	7/21/1999	1,835	2	18.29	0.6393	9.1	7.3	22.5	0.0000	13.1	2.4	2	4.248	36.560	1	22.410	2.2
VR-14	7/22/1999	2,440	1	20.44	0.6981	9.1	7.3	0.8	0.0000	9.5	3.7	2	7.100	32.086	1	24.838	3.5
VR-15	8/10/1999	1,650	2	23.23	0.8091	0.8	0.0	0.5	2.0145	4.2	3.8	1	591.806	nd	0	nd	nd
VR-15bt	8/10/1999	nd	0	nd	nd	nd	nd	nd	nd	nd	nd	0	nd	nd	0	nd	nd
VR-16	8/11/1999	1,455	2	24.30	0.8196	1.1	0.1	8.9	0.0000	5.2	5.2	1	54.889	nd	0	nd	nd
VR-17	8/11/1999	785	2	19.39	0.6849	4.5	2.8	39.0	0.0000	11.4	2.3	1	6.038	47.050	1	22.899	2.0
VR-18	8/12/1999	2,880	2	24.45	0.7584	0.7	0.1	4.4	0.0044	9.8	8.2	1	27.063	47.544	0	nd	nd
VR-19	8/24/1999	875	2	27.37	0.8709	4.2	2.3	5.3	0.0000	6.1	8.3	1	9.293	71.089	1	36.655	9.0
VR-20	8/24/1999	1,730	1	17.85	0.6554	6.5	5.1	31.4	0.0000	10.4	0.9	2	6.806	36.038	1	20.434	0.9
VR-21	8/25/1999	1,010	1	21.17	0.7161	3.3	2.5	7.6	0.0000	11.0	4.1	1	6.235	45.445	1	25.023	3.2
VR-22	8/26/1999	1,230	2	19.22	0.6791	6.1	4.1	10.8	0.0000	11.1	2.3	1	8.739	48.426	1	22.828	2.1
VR-23	8/26/1999	935	1	18.89	0.6498	0.4	0.4	3.6	0.5795	14.5	2.9	2	32.699	30.048	0	nd	nd
VR-24	10/27/1999	1,020	1	25.58	0.8371	0.7	0.1	3.7	0.0017	6.2	6.6	2	24.348	51.575	0	nd	nd
VR-25	10/27/1999	705	2	21.84	0.7832	2.2	0.0	0.7	0.8643	5.7	2.4	1	398.015	nd	0	nd	nd
VR-26	10/28/1999	2,310	2	20.89	0.7292	9.6	5.7	2.7	0.0000	7.1	3.2	1	6.131	39.155	1	24.638	3.1

Table 8. Summary of averaged dissolved gas compositions (nitrogen, argon, oxygen, carbon dioxide, methane, helium, and neon), recharge temperatures, and quantities of excess air in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Rech. Elev., recharge elevation is land surface; ft, feet; n_{dg}, number of dissolved gas samples averaged; N_2, nitrogen; Ar, argon; O_2, oxygen; CO_2, carbon dioxide; CH_4, methane; mg/L, milligrams per liter; Rech. temp., recharge temperature; °C, degrees Celsius; Ex. air, excess air; cc_{STP}/L, cubic centimeters at standard temperature and pressure per liter; $n_{He\text{-}Negc}$, number of helium and neon gas samples averaged from the gas chromatography procedure; n_{Ne}, number of neon gas samples averaged from the mass-spectrometric procedure; cc_{STP}/g, cubic centimeters at standard temperature and pressure per gram; nd, not determined; Recharge temperatures in italics were estimated from local mean annual air temperatures, not from dissolved gas data and quantities of excess air were assumed to be zero. See figure 1 for location of wells and springs.]

VAS no.	Date	Rech. Elev. (ft)	n_{dg}	N_2 (mg/L)[1]	Ar (mg/L)[1]	Field O_2 (mg/L)	Lab O_2 (mg/L)[1]	CO_2 (mg/L)[1]	CH_4 (mg/L)[1]	N_2-Ar Rech. temp. (°C)	N_2-Ar Ex. air (cc_{STP}/L)	$n_{He\text{-}Negc}$	Helium $\times10^{-8}$ (cc_{STP}/g)[2]	Neon $\times10^{-8}$ (cc_{STP}/g)[2]	n_{Ne}	Neon $\times10^{-8}$ (cc_{STP}/g)[3]	Neon Ex. air (cc_{STP}/L)[4]
VR-27	10/28/1999	1,670	1	20.84	0.7264	8.5	4.8	3.5	0.0000	8.3	3.1	2	14.652	41.282	0	nd	nd
VR-28	7/12/2000	3,530	2	20.19	0.6904	0.3	0.1	4.2	0.2368	8.3	3.7	1	8.803	80.460	1	23.712	3.1
VR-29	7/13/2000	1,640	2	24.05	0.7874	0.9	0.1	36.3	2.6820	7.7	6.2	1	24.513	36.870	0	nd	nd
VR-30	7/13/2000	1,470	2	19.04	0.6559	1.5	0.1	7.3	0.0468	13.2	3.0	1	169.931	nd	0	nd	nd
VR-31	7/17/2000	2,210	2	22.63	0.7698	0.3	0.1	3.6	3.3655	6.2	4.5	1	157.459	nd	0	nd	nd
VR-32	7/17/2000	2,080	2	21.45	0.7185	1.3	0.2	27.7	0.0008	9.7	4.6	1	10.309	34.148	1	25.174	3.5
VR-33	7/18/2000	1,600	2	21.61	0.7363	7.3	5.7	10.9	0.0000	8.7	4.1	1	6.414	25.583	1	25.769	3.6
VR-34	7/18/2000	1,275	2	17.36	0.6542	5.3	3.0	1.8	0.0000	10.2	0.1	1	19.269	24.496	0	nd	nd
VR-35	7/19/2000	2,450	2	20.22	0.6773	0.5	0.4	17.5	0.0076	11.5	4.2	1	7.362	26.696	1	21.526	1.8
VR-35b	7/19/2000	nd	0	nd	nd	nd	nd	nd	nd	nd	nd	0	nd	nd	0	nd	nd
VR-36	7/20/2000	2,120	2	17.45	0.6265	6.0	3.6	12.5	0.0000	12.4	1.5	1	5.471	20.826	1	19.753	0.8
VR-37	7/17/2000	2,030	2	18.92	0.6621	7.9	5.0	4.7	0.0000	11.3	2.5	2	8.437	24.684	1	23.199	2.6
VR-37d	7/17/2000	2,030	2	19.02	0.6658	7.9	5.0	4.7	0.0000	11.0	2.6	0	nd	nd	1	22.644	2.3
VR-38	7/18/2000	2,200	2	23.67	0.7467	8.9	7.0	6.7	0.0000	10.6	7.3	1	6.648	37.080	1	30.363	6.5
VR-39	7/18/2000	2,020	2	20.54	0.6992	6.8	2.7	4.5	0.0000	10.2	3.8	0	nd	nd	1	24.507	3.2
VR-40	7/19/2000	2,010	2	21.54	0.7221	1.2	0.1	16.3	0.0000	9.5	4.6	1	6.525	33.007	1	24.850	3.3
VR-41	7/19/2000	1,990	2	22.15	0.7335	1.1	0.1	23.8	0.0000	9.5	5.2	1	6.422	nd	0	nd	nd
VR-42	7/20/2000	3,930	2	18.19	0.6480	12.7	7.2	23.0	0.0000	8.6	2.0	1	4.085	21.515	1	21.076	1.9
VR-42bt	7/20/2000	nd	0	nd	nd	nd	nd	nd	nd	nd	nd	0	nd	nd	0	nd	nd
VR-43	7/20/2000	3,845	2	21.95	0.7223	0.9	0.1	16.8	0.0040	7.6	5.4	1	5.716	28.566	1	27.596	5.3
VR-44	7/20/2000	3,910	2	18.99	0.6429	10.0	5.6	25.6	0.0000	10.9	3.6	1	5.201	27.013	1	23.997	3.7
VR-45	7/25/2000	1,425	2	22.27	0.7511	8.1	5.4	8.6	0.0008	8.6	4.6	1	6.629	31.782	0	nd	nd
VR-46	7/25/2000	1,715	2	24.57	0.7846	6.2	3.8	5.2	0.0000	8.8	7.2	1	88.195	nd	0	nd	nd
VR-47	7/26/2000	1,360	2	20.54	0.7079	6.8	4.8	2.2	0.0000	10.2	3.4	0	nd	nd	1	24.466	2.9
VTDW-01	9/16/1999	2,800	1	17.66	0.6283	4.9	4.1	22.4	0.0000	11.6	1.9	1	6.731	30.181	1	18.970	0.6
VTDW-03A	7/15/2000	2,730	2	17.25	0.6150	2.3	0.1	4.0	0.0000	12.5	1.7	1	7.623	26.122	1	19.529	0.9

Table 8. Summary of averaged dissolved gas compositions (nitrogen, argon, oxygen, carbon dioxide, methane, helium, and neon), recharge temperatures, and quantities of excess air in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Rech. Elev., recharge elevation is land surface; ft, feet; n_{dg}, number of dissolved gas samples averaged; N_2, nitrogen; Ar, argon; O_2, oxygen; CO_2, carbon dioxide; CH_4, methane; mg/L, milligrams per liter; Rech. temp., recharge temperature; ºC, degrees Celsius; Ex. air, excess air; cc_{STP}/L, cubic centimeters at standard temperature and pressure per liter; $n_{He\text{-}Negc}$, number of helium and neon gas samples averaged from the gas chromatography procedure; n_{Ne}, number of neon gas samples averaged from the mass-spectrometric procedure; cc_{STP}/g, cubic centimeters at standard temperature and pressure per gram; nd, not determined; Recharge temperatures in italics were estimated from local mean annual air temperatures, not from dissolved gas data and quantities of excess air were assumed to be zero. See figure 1 for location of wells and springs.]

VAS no.	Date	Rech. Elev. (ft)	n_{dg}	N_2 (mg/L)[1]	Ar (mg/L)[1]	Field O_2 (mg/L)	Lab O_2 (mg/L)[1]	CO_2 (mg/L)[1]	CH_4 (mg/L)[1]	N_2-Ar Rech. temp. (°C)	N_2-Ar Ex. air (cc_{STP}/L)	$n_{He\text{-}Negc}$	Helium $\times 10^{-8}$ (cc_{STP}/g)[2]	Neon $\times 10^{-8}$ (cc_{STP}/g)[2]	n_{Ne}	Neon $\times 10^{-8}$ (cc_{STP}/g)[3]	Neon Ex. air (cc_{STP}/L)[4]
VTDW-03B	7/15/2000	2,730	2	16.66	0.5963	3.5	0.1	4.4	0.0000	13.7	1.5	1	6.278	24.729	1	19.352	0.9
VTDW-07A	7/14/2000	2,740	2	17.19	0.6131	1.7	0.1	5.0	0.0000	12.6	1.7	1	6.299	20.640	1	19.643	1.0
VTDW-07B	7/14/2000	2,740	0	nd	nd	10.4	nd	nd	nd	*13.7*	*0.0*	1	1.282	5.694	0	nd	nd
VTDW-08	9/16/1999	2,740	1	16.93	0.5827	8.6	5.3	29.2	0.0000	16.2	2.5	2	5.764	17.805	1	19.917	1.5

[1] Water samples for the determination of the dissolved gases (N_2, Ar, O_2, CO_2, and CH_4) in the U.S. Geological Survey Dissolved Gas Laboratory, Reston, Va., were analyzed using gas chromatography procedures (See http://water.usgs.gov/lab/cfc/).

[2] Water samples for the determination of He and Ne in the USGS Chlorofluorocarbon Laboratory in Reston, Va., were analyzed using gas chromatography procedure with a thermal conductivity detector, which is similar to the procedure described by Sugisaki and others (1982) (See http://water.usgs.gov/lab/cfc/).

[3] Water samples for the determination of Ne in the Noble Gas Laboratory at Lamont-Doherty Earth Observatory of Columbia University, Palisades, N.Y., were analyzed by mass-spectrometric procedures outlined in Ekwurzel and others (1994) and Ludin and others (1998).

[4] Ne excess air quantities are based on Ne concentrations as determined by mass-spectrometric procedures.

Table 9. Summary of averaged chlorofluorocarbon concentrations1 and calculated atmospheric partial pressures in water samples from wells and springs in Virginia, 1998-2000

[VAS, Virginia Aquifer Susceptibility study; CFC-11, (trichlorofluoromethane, $CFCl_3$); CFC-12, (dichlorodifluoromethane, CF_2Cl_2); CFC-113, (trichlorotrifluoroethane, $C_2F_3Cl_3$); pg/kg, picograms per kilogram; Rech. temp., recharge temperature; Rech. elev., recharge elevation; ºC, degrees Celsius; pptv, parts per trillion by volume; N/A, not applicable; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Average concentration in water			Rech. temp. (ºC)	Rech. elev. (feet)	Average calculated atmospheric partial pressure		
		CFC-11 (pg/kg)	CFC-12 (pg/kg)	CFC-113 (pg/kg)			CFC-11 (pptv)	CFC-12 (pptv)	CFC-113 (pptv)
AP-01	7/10/2000	4,113.4	490.2	151.5	13.0	1,130	1,759.7	902.3	156.3
AP-02	7/10/2000	28.8	10.7	<1.0	10.1	1,440	10.6	17.2	0.0
AP-03	7/20/2000	339.7	229.5	47.2	14.0	1,735	156.4	452.3	52.7
AP-03d	7/20/2000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AP-04	7/11/2000	4.1	5.6	<1.0	12.3	1,840	1.7	10.3	0.0
AP-05	7/12/2000	8.2	22.4	3.0	15.2	1,940	4.1	47.2	3.6
AP-06	7/13/2000	15.8	46.0	5.4	9.8	2,340	6.0	76.0	4.9
AP-07	7/13/2000	4.7	<0.3	<1.0	12.3	2,780	2.0	0.0	0.0
AP-08	7/10/2000	262.0	182.4	27.6	11.6	2,710	110.1	332.4	27.7
AP-09	7/10/2000	40.1	13.4	<1.0	13.7	1,735	18.2	26.1	0.0
AP-10	7/11/2000	1.1	4.1	<1.0	12.0	1,560	0.5	7.3	0.0
AP-11	7/11/2000	3.9	8.0	<1.0	12.0	1,755	1.6	14.4	0.0
AP-12	7/12/2000	24.6	3,244.6	7.8	13.7	1,660	11.1	6,297.2	8.5
AP-13	7/12/2000	8.8	4.3	<1.0	9.4	1,670	3.2	6.8	0.0
BR-01	7/19/1999	134.7	130.2	9.4	13.5	750	58.3	241.8	9.9
BR-02	7/19/1999	545.7	333.2	71.4	13.0	690	229.3	602.5	72.4
BR-03	7/20/1999	6,226.2	343.5	88.3	9.2	3,440	2,359.0	572.4	79.0
BR-04	7/20/1999	9.4	171.3	<1.0	10.6	1,290	3.5	282.5	0.0
BR-05	8/25/1999	3,624.3	26,624.6	462.8	9.8	1,040	1,302.2	41,907.3	394.3
BR-06	9/13/1999	103.6	1283.8	237.5	10.7	660	38.6	2,082.4	210.6
BR-07	9/14/1999	104.4	1,989.9	165.5	19.9	490	61.4	4,854.6	243.3
BR-08	9/16/1999	9,853.1	98,347.9	215.2	12.9	2,450	4,405.9	189,304.3	231.9
BR-09	10/18/1999	23.3	185.1	61.8	11.5	940	9.1	314.2	57.8
BR-10	10/26/1999	4,845.7	12,997.5	4,031.8	13.1	500	2,035.4	23,476.1	4,085.4
CP-01	6/23/1998	<0.3	<0.3	<1.0	9.1	350	0.0	0.0	0.0
CP-01d	6/23/1998	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CP-02	6/24/1998	<0.3	<0.3	<1.0	13.1	200	0.0	0.0	0.0
CP-03	6/25/1998	<0.3	<0.3	<1.0	9.7	350	0.0	0.0	0.0
CP-04	7/1/1998	<0.3	<0.3	<1.0	5.2	350	0.0	0.0	0.0
CP-05	7/6/1998	<0.3	<0.3	<1.0	5.4	250	0.0	0.0	0.0
CP-06	7/6/1998	<0.3	<0.3	<1.0	8.6	250	0.0	0.0	0.0
CP-07	7/7/1998	<0.3	<0.3	<1.0	4.6	250	0.0	0.0	0.0
CP-08	7/7/1998	<0.3	<0.3	<1.0	6.0	250	0.0	0.0	0.0
CP-09	7/8/1998	<0.3	<0.3	<1.0	10.7	100	0.0	0.0	0.0
CP-10	7/8/1998	<0.3	<0.3	<1.0	8.1	250	0.0	0.0	0.0
CP-11	7/9/1998	<0.3	<0.3	<1.0	9.2	100	0.0	0.0	0.0
CP-11b	7/9/1998	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CP-12	7/14/1998	3.5	0.5	<1.0	12.8	50	1.4	0.9	0.0
CP-13	7/15/1998	<0.3	<0.3	<1.0	8.8	50	0.0	0.0	0.0
CP-14	7/15/1998	500.9	497.1	397.8	16.5	50	245.7	1,029.5	479.1
CP-15	7/15/1998	<0.3	<0.3	<1.0	8.4	50	0.0	0.0	0.0

Table 9. Summary of averaged chlorofluorocarbon concentrations1 and calculated atmospheric partial pressures in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; CFC-11, (trichlorofluoromethane, $CFC1_3$); CFC-12, (dichlorodifluoromethane, CF_2Cl_2); CFC-113, (trichlorotrifluoroethane, $C_2F_3Cl_3$); pg/kg, picograms per kilogram; Rech. temp., recharge temperature; Rech. elev., recharge elevation; ºC, degrees Celsius; pptv, parts per trillion by volume; N/A, not applicable; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Average concentration in water			Rech. temp. (ºC)	Rech. elev. (feet)	Average calculated atmospheric partial pressure		
		CFC-11 (pg/kg)	CFC-12 (pg/kg)	CFC-113 (pg/kg)			CFC-11 (pptv)	CFC-12 (pptv)	CFC-113 (pptv)
CP-16	7/16/1998	<0.3	<0.3	<1.0	10.4	50	0.0	0.0	0.0
CP-17	7/16/1998	<0.3	<0.3	<1.0	12.4	50	0.0	0.0	0.0
CP-18	7/27/1998	2.5	<0.3	<1.0	10.2	250	0.9	0.0	0.0
CP-19	7/27/1998	0.6	<0.3	<1.0	11.6	250	0.2	0.0	0.0
CP-20	7/28/1998	<0.3	<0.3	<1.0	8.3	350	0.0	0.0	0.0
CP-21	7/29/1998	<0.3	34.6	<1.0	14.9	50	0.0	66.7	0.0
CP-22	7/30/1998	<0.3	<0.3	<1.0	11.7	250	0.0	0.0	0.0
CP-23	8/3/1998	<0.3	<0.3	<1.0	6.9	200	0.0	0.0	0.0
CP-23d	8/3/1998	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CP-24	8/4/1998	<0.3	<0.3	<1.0	9.3	300	0.0	0.0	0.0
CP-25	8/4/1998	4.4	1.8	0.4	9.9	300	1.5	2.8	0.3
CP-26	8/5/1998	1,620.3	381.3	634.3	13.3	100	679.3	686.4	642.4
CP-27	8/6/1998	<0.3	<0.3	<1.0	8.9	350	0.0	0.0	0.0
CP-28	8/17/1998	<0.3	<0.3	<1.0	9.8	250	0.0	0.0	0.0
CP-29	8/17/1998	<0.3	<0.3	<1.0	7.6	250	0.0	0.0	0.0
CP-30	8/18/1998	<0.3	<0.3	<1.0	3.8	250	0.0	0.0	0.0
CP-31	8/19/1998	<0.3	<0.3	<1.0	7.0	250	0.0	0.0	0.0
CP-32	8/31/1998	<0.3	<0.3	<1.0	4.9	250	0.0	0.0	0.0
CP-33	8/31/1998	<0.3	<0.3	<1.0	9.6	250	0.0	0.0	0.0
CP-34	8/31/1998	11.2	20.8	6.9	15.3	200	5.2	41.2	7.8
CP-34d	8/31/1998	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CP-35	9/1/1998	<0.3	<0.3	<1.0	7.5	250	0.0	0.0	0.0
CP-36	9/1/1998	2.0	1.9	<1.0	7.0	250	0.6	2.5	0.0
CP-37	9/2/1998	<0.3	<0.3	<1.0	6.5	250	0.0	0.0	0.0
CP-38	9/2/1998	<0.3	<0.3	<1.0	5.2	250	0.0	0.0	0.0
CP-39	9/2/1998	<0.3	<0.3	<1.0	9.1	250	0.0	0.0	0.0
CP-40	9/3/1998	3.1	2.4	<1.0	6.0	250	0.9	3.0	0.0
CP-41	9/10/1998	<0.3	<0.3	<1.0	7.1	250	0.0	0.0	0.0
CP-42	9/10/1998	<0.3	<0.3	<1.0	7.2	250	0.0	0.0	0.0
CP-43	10/1/1998	<0.3	<0.3	<1.0	5.9	150	0.0	0.0	0.0
CP-44	10/5/1998	0.7	<0.3	<1.0	6.9	150	0.2	0.0	0.0
CP-45	10/5/1998	<0.3	135.6	<1.0	13.1	50	0.0	241.0	0.0
CP-46	10/6/1998	315.2	159.5	37.5	13.2	150	131.7	286.4	37.8
CP-47	10/6/1998	0.4	1.2	<1.0	8.1	250	0.1	1.6	0.0
CP-48	10/7/1998	1,255.6	644.7	227.1	13.2	150	523.3	1,154.7	228.4
CP-49	10/27/1998	0.6	<0.3	<1.0	11.3	100	0.2	0.0	0.0
CP-50	10/28/1998	626.6	308.0	98.4	13.3	200	262.9	555.3	99.7
CP-51	11/4/1998	<0.3	<0.3	<1.0	8.9	250	0.0	0.0	0.0
CP-51d	11/4/1998	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PD-01	6/28/1999	1,719.5	199.4	33.4	10.0	362	608.5	308.8	28.0
PD-02	6/29/1999	6.9	103.6	3.0	13.0	775	2.9	187.8	3.0

Table 9. Summary of averaged chlorofluorocarbon concentrations1 and calculated atmospheric partial pressures in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; CFC-11, (trichlorofluoromethane, $CFC1_3$); CFC-12, (dichlorodifluoromethane, CF_2Cl_2); CFC-113, (trichlorotrifluoroethane, $C_2F_3Cl_3$); pg/kg, picograms per kilogram; Rech. temp., recharge temperature; Rech. elev., recharge elevation; ºC, degrees Celsius; pptv, parts per trillion by volume; N/A, not applicable; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Average concentration in water			Rech. temp. (ºC)	Rech. elev. (feet)	Average calculated atmospheric partial pressure		
		CFC-11 (pg/kg)	CFC-12 (pg/kg)	CFC-113 (pg/kg)			CFC-11 (pptv)	CFC-12 (pptv)	CFC-113 (pptv)
PD-03	6/30/1999	40.7	179.9	6.5	14.6	558	18.6	349.7	7.2
PD-04	6/30/1999	54.7	1,782.4	9.9	12.9	860	23.0	3,227.3	10.0
PD-05	7/1/1999	5,315.0	606.2	7.9	14.2	500	2,365.1	1,152.9	8.6
PD-06	8/23/1999	247.9	975.3	556.2	6.6	355	72.2	1,269.2	377.6
PD-07	8/23/1999	40.0	210.1	274.7	12.0	415	15.8	359.6	260.7
PD-08	8/30/1999	503.3	254.4	294.2	13.5	480	215.2	466.9	304.1
PD-09	8/31/1999	26.7	88.4	73.7	9.9	120	9.3	135.1	61.0
PD-10	9/1/1999	942.2	313.8	129.8	14.9	535	434.5	616.1	145.8
PD-11	9/1/1999	1,553.1	768.0	89.3	14.3	555	696.0	1,470.2	97.1
PD-12	9/1/1999	3.8	120.5	41.6	13.7	220	1.6	221.9	43.2
PD-13	9/2/1999	548.5	305.9	141.7	11.2	360	207.6	503.0	128.1
PD-14	9/2/1999	458.6	308.1	87.4	11.3	430	174.1	508.3	79.3
PD-15	9/2/1999	42.8	129.0	61.1	14.1	350	18.8	242.7	65.2
PD-15d	9/2/1999	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PD-16	9/13/1999	259.5	399.0	226.0	9.2	290	87.5	591.3	180.0
PD-17	9/13/1999	262.2	111.6	219.1	9.4	325	89.3	167.0	176.5
PD-18	10/18/1999	30.3	174.6	205.6	11.5	315	11.6	289.9	188.2
PD-19	10/19/1999	306.4	190.8	70.1	10.6	400	112.2	304.8	61.1
PD-20	10/19/1999	18.8	1434.3	45.1	10.8	390	6.9	2,311.2	39.7
PD-20b	10/20/1999	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PD-21	10/25/1999	3.8	8.1	29.3	11.5	295	1.5	13.5	26.7
PD-22	10/25/1999	415.9	161.5	37.0	11.0	425	155.9	263.4	33.0
PD-23	10/25/1999	3,358.5	1,232.5	347.6	9.3	175	1,134.1	1,829.1	277.5
PD-24	10/26/1999	19,410.5	9,472.1	776.3	11.0	345	7,236.0	15,366.8	690.3
PD-25	6/27/2000	561.0	509.2	14.0	12.0	1,085	227.4	893.1	13.6
PD-26	6/27/2000	246.2	297.9	32.0	8.8	875	82.7	441.4	25.4
PD-27	6/28/2000	57.8	147.7	14.5	10.1	360	20.5	229.7	12.2
PD-28	6/28/2000	399.1	104.4	8.0	12.8	318	163.8	184.5	7.9
PD-29	6/29/2000	2.7	393.4	<1.0	17.0	335	1.4	841.5	0.0
PD-30	6/29/2000	32.7	68.9	11.3	9.3	258	11.1	102.5	9.1
VB-01	5/13/1999	2.5	1.6	<1.0	10.8	10	0.9	2.5	0.0
VB-02	5/14/1999	2.2	0.3	<1.0	15.0	10	1.0	0.6	0.0
VB-03	5/10/1999	1.1	76.7	<1.0	14.0	10	0.5	141.9	0.0
VB-04	5/12/1999	0.8	1.0	<1.0	13.4	10	0.4	1.9	0.0
VB-05	8/14/2000	0.3	0.0	<1.0	11.2	10	0.1	0.0	0.0
VB-05b	8/14/2000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
VB-06	8/11/2000	0.6	2.8	<0.3	10.3	10	0.2	4.4	0.0
VB-07	8/10/2000	75.5	10.7	15.3	11.6	10	28.7	17.7	13.9
VB-08	8/9/2000	<0.3	6.3	4.8	11.8	10	0.0	10.5	4.4
VB-09	8/16/2000	4.9	5.1	3.7	10.8	10	1.8	8.1	3.2
VB-10	8/17/2000	1.2	3.7	<1.0	9.8	10	0.4	5.6	0.0

Table 9. Summary of averaged chlorofluorocarbon concentrations1 and calculated atmospheric partial pressures in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; CFC-11, (trichlorofluoromethane, $CFC1_3$); CFC-12, (dichlorodifluoromethane, CF_2Cl_2); CFC-113, (trichlorotrifluoroethane, $C_2F_3Cl_3$); pg/kg, picograms per kilogram; Rech. temp., recharge temperature; Rech. elev., recharge elevation; ºC, degrees Celsius; pptv, parts per trillion by volume; N/A, not applicable; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Average concentration in water			Rech. temp. (ºC)	Rech. elev. (feet)	Average calculated atmospheric partial pressure		
		CFC-11 (pg/kg)	CFC-12 (pg/kg)	CFC-113 (pg/kg)			CFC-11 (pptv)	CFC-12 (pptv)	CFC-113 (pptv)
VB-11	8/16/2000	23.8	6.3	4.3	10.7	10	8.6	10.0	3.7
VB-12	8/15/2000	0.9	10.5	11.4	10.5	10	0.3	16.4	9.7
VB-13	8/8/2000	4.0	<0.3	<1.0	10.5	10	1.4	0.0	0.0
VB-14	8/7/2000	<0.3	<0.3	<1.0	9.8	10	0.0	0.0	0.0
VB-14d	8/7/2000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
VR-01	7/6/1999	5.7	<0.3	2.0	7.8	1,175	1.8	0.0	1.5
VR-02	7/6/1999	282.5	114.3	22.6	9.8	1,170	101.6	180.2	19.2
VR-03	7/7/1999	629.8	322.5	421.1	9.5	1,360	224.3	504.2	354.8
VR-03d	7/7/1999	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
VR-04	7/7/1999	503.3	203.0	672.7	8.7	1,320	171.7	305.3	540.8
VR-05	7/8/1999	497.4	307.8	363.4	14.1	725	222.2	588.0	393.8
VR-06	7/8/1999	390.1	316.7	46,082.1	8.4	1,080	129.3	463.9	35,934.6
VR-07	7/8/1999	201.5	191.7	129,128.4	7.2	1,070	62.1	263.3	93,060.6
VR-08	7/9/1999	86.0	116.3	184.9	9.4	1,050	30.1	178.7	152.9
VR-09	7/9/1999	190.2	135.6	23.8	9.6	970	67.1	209.8	19.8
VR-10	7/9/1999	388.2	241.4	23.1	9.5	1,070	137.0	373.7	19.3
VR-11	7/9/1999	2.1	4.7	14.9	9.1	1,140	0.7	7.2	12.2
VR-12	7/21/1999	317.8	429.7	15.4	10.8	1,590	122.7	723.0	14.2
VR-13	7/21/1999	1,197.0	304.3	192.7	13.1	1,835	527.8	576.9	204.9
VR-14	7/22/1999	74.1	43.6	253.4	9.5	2,440	27.5	71.1	222.6
VR-15	8/10/1999	3.6	4.8	907.9	4.2	1,650	0.9	5.8	550.3
VR-15bt	8/10/1999	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
VR-16	8/11/1999	9.6	22.5	485.9	5.2	1,455	2.7	28.1	312.4
VR-17	8/11/1999	579.8	315.5	517.8	11.4	785	225.2	531.9	480.9
VR-18	8/12/1999	19.1	54.1	265.9	9.8	2,880	7.3	90.8	241.5
VR-19	8/24/1999	523.1	844.2	115.2	6.1	875	150.4	1,088.0	77.0
VR-20	8/24/1999	532.6	253.0	191.6	10.4	1,730	202.4	419.8	173.2
VR-21	8/25/1999	170.4	142.1	136.9	11.0	1,010	65.2	236.6	125.0
VR-22	8/26/1999	267.0	139.4	184.1	11.1	1,230	103.5	235.0	170.3
VR-23	8/26/1999	265.8	5,349.9	191.0	14.5	935	121.8	10,462.3	212.6
VR-24	10/27/1999	6.1	5.6	10.8	6.2	1,020	1.8	7.3	7.3
VR-25	10/27/1999	16.5	36.8	22.7	5.7	705	4.6	46.1	14.7
VR-26	10/28/1999	508.3	243.2	61.8	7.1	2,310	164.0	349.3	46.6
VR-27	10/28/1999	408.0	215.5	54.0	8.3	1,670	137.2	320.4	42.7
VR-28	7/12/2000	9.1	21.3	2.0	8.3	3,530	3.3	34.0	1.7
VR-29	7/13/2000	8.2	8.5	<1.0	7.8	1,640	2.7	12.3	0.0
VR-30	7/13/2000	77.5	61.0	12.5	13.2	1,470	33.9	114.6	13.2
VR-31	7/17/2000	14.4	8.3	<1.0	6.2	2,210	4.4	11.3	0.0
VR-32	7/17/2000	23.6	70.5	3.4	9.7	2,080	8.7	114.3	2.9
VR-33	7/18/2000	588.8	396.2	89.0	8.7	1,600	202.7	601.6	72.2
VR-34	7/18/2000	87.3	147.1	39.9	10.2	1,275	32.3	238.3	35.2

Table 9. Summary of averaged chlorofluorocarbon concentrations1 and calculated atmospheric partial pressures in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; CFC-11, (trichlorofluoromethane, $CFC1_3$); CFC-12, (dichlorodifluoromethane, CF_2Cl_2); CFC-113, (trichlorotrifluoroethane, $C_2F_3Cl_3$); pg/kg, picograms per kilogram; Rech. temp., recharge temperature; Rech. elev., recharge elevation; ºC, degrees Celsius; pptv, parts per trillion by volume; N/A, not applicable; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Average concentration in water			Rech. temp. (ºC)	Rech. elev. (feet)	Average calculated atmospheric partial pressure		
		CFC-11 (pg/kg)	CFC-12 (pg/kg)	CFC-113 (pg/kg)			CFC-11 (pptv)	CFC-12 (pptv)	CFC-113 (pptv)
VR-35	7/19/2000	1.3	3.1	<1.0	11.4	2,450	0.5	5.6	0.0
VR-35b	7/19/2000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
VR-36	7/20/2000	487.0	255.9	60.4	12.4	2,120	209.9	476.1	62.6
VR-37	7/17/2000	163.5	89.7	17.5	11.2	2,030	65.5	156.3	16.7
VR-37d	7/17/2000	N/A	N/A	N/A	nd	nd	nd	nd	nd
VR-38	7/18/2000	310.8	192.1	41.7	10.6	2,200	121.6	327.8	38.8
VR-39	7/18/2000	137.0	63.3	11.9	10.2	2,020	52.0	105.2	10.7
VR-40	7/19/2000	846.9	36.8	15.2	9.5	2,010	309.9	59.1	13.2
VR-41	7/19/2000	64.8	31.0	19.4	9.5	1,990	23.6	49.6	16.7
VR-42	7/20/2000	554.5	1,408.1	66.3	8.6	3,930	207.2	2,322.2	58.4
VR-42bt	7/20/2000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
VR-43	7/20/2000	54.5	65.8	11.3	7.6	3,845	19.1	102.6	9.3
VR-44	7/20/2000	598.7	1,832.8	43.3	10.9	3,910	254.5	3,390.7	43.9
VR-45	7/25/2000	253.1	110.8	12.7	8.6	1,425	86.0	166.0	10.2
VR-46	7/25/2000	208.1	103.6	26.4	8.8	1,715	72.2	158.5	21.6
VR-47	7/26/2000	649.3	303.8	433.2	10.2	1,360	240.4	491.9	381.0
VTDW-01	9/16/1999	406.5	271.8	154.5	11.6	2,800	172.0	498.7	156.5
VTDW-03A	7/15/2000	114.6	75.8	16.9	12.5	2,730	50.7	144.7	18.0
VTDW-03B	7/15/2000	131.1	86.8	18.9	13.7	2,730	61.7	175.0	21.5
VTDW-07A	7/14/2000	29.5	87.0	8.7	12.6	2,740	13.1	167.2	9.4
VTDW-07B	7/14/2000	85.2	69.1	13.2	13.7	2,740	40.1	139.6	15.0
VTDW-08	9/16/1999	615.6	299.8	164.3	16.2	2,740	329.6	678.7	215.7

Table 10. Concentrations of chlorofluorocarbons and sulfur hexafluoride in North American air, 1930-2000

[CFC-11, (trichlorofluoromethane, $CFCl_3$); CFC-12, (dichlorodifluoromethane, CF_2Cl_2); CFC-113, (trichlorotrifluoroethane, $C_2F_3Cl_3$); SF_6, sulfur hexafluoride; pptv, parts per trillion by volume; nd, not determined. Data from Plummer and others (2000) and E. Busenberg, U.S. Geological Survey, written commun., 2001]

Year	CFC-11 pptv	CFC-12 pptv	CFC-113 pptv	SF_6 pptv	Year	CFC-11 pptv	CFC-12 pptv	CFC-113 pptv	SF_6 pptv	Year	CFC-11 pptv	CFC-12 pptv	CFC-113 pptv	SF_6 pptv
1930.0	0.000	0.000	0.000	0.054	1955.0	3.601	16.869	0.641	0.055	1980.0	169.667	306.192	22.999	0.825
1930.5	0.000	0.000	0.000	0.054	1955.5	4.122	18.121	0.699	0.056	1980.5	173.918	312.300	24.594	0.879
1931.0	0.000	0.003	0.000	0.054	1956.0	4.767	19.579	0.758	0.056	1981.0	177.127	317.525	26.189	0.935
1931.5	0.000	0.005	0.000	0.054	1956.5	5.412	21.036	0.823	0.057	1981.5	180.892	328.408	27.838	0.993
1932.0	0.000	0.008	0.000	0.054	1957.0	6.131	22.692	0.889	0.058	1982.0	185.033	338.058	29.488	1.054
1932.5	0.000	0.011	0.000	0.054	1957.5	6.850	24.348	0.964	0.059	1982.5	189.558	347.025	31.316	1.117
1933.0	0.000	0.014	0.000	0.054	1958.0	7.506	26.075	1.038	0.060	1983.0	194.542	355.758	33.144	1.182
1933.5	0.000	0.016	0.000	0.054	1958.5	8.162	27.801	1.125	0.061	1983.5	199.292	366.225	35.429	1.250
1934.0	0.000	0.022	0.000	0.054	1959.0	8.822	29.729	1.212	0.062	1984.0	203.242	372.478	37.713	1.320
1934.5	0.000	0.027	0.000	0.054	1959.5	9.482	31.657	1.311	0.064	1984.5	207.350	380.000	40.415	1.392
1935.0	0.000	0.035	0.000	0.054	1960.0	10.360	33.960	1.409	0.066	1985.0	212.592	389.000	43.118	1.466
1935.5	0.000	0.043	0.000	0.054	1960.5	11.237	36.263	1.522	0.069	1985.5	218.658	396.750	46.003	1.543
1936.0	0.000	0.057	0.000	0.054	1961.0	12.375	38.836	1.634	0.072	1986.0	224.417	407.933	48.887	1.622
1936.5	0.000	0.070	0.000	0.054	1961.5	13.513	41.409	1.761	0.076	1986.5	229.383	416.633	52.061	1.704
1937.0	0.000	0.092	0.000	0.054	1962.0	14.948	44.365	1.888	0.079	1987.0	234.967	426.591	55.235	1.788
1937.5	0.000	0.114	0.000	0.054	1962.5	16.382	47.321	2.035	0.084	1987.5	242.600	442.064	58.787	1.874
1938.0	0.002	0.146	0.000	0.054	1963.0	18.138	50.783	2.182	0.088	1988.0	250.250	452.058	62.339	1.962
1938.5	0.005	0.178	0.000	0.054	1963.5	19.895	54.245	2.350	0.095	1988.5	255.600	461.517	66.052	2.053
1939.0	0.007	0.224	0.000	0.054	1964.0	21.976	58.268	2.518	0.101	1989.0	259.100	468.975	69.765	2.146
1939.5	0.010	0.270	0.000	0.054	1964.5	24.057	62.291	2.709	0.110	1989.5	263.667	476.217	72.819	2.241
1940.0	0.012	0.332	0.000	0.054	1965.0	26.416	66.825	2.901	0.118	1990.0	266.809	484.967	75.874	2.339
1940.5	0.014	0.394	0.000	0.054	1965.5	28.775	71.358	3.120	0.129	1990.5	268.799	489.450	78.034	2.439
1941.0	0.016	0.474	0.000	0.054	1966.0	31.398	76.389	3.339	0.139	1991.0	270.429	495.995	80.194	2.541
1941.5	0.019	0.554	0.000	0.054	1966.5	34.022	81.420	3.590	0.151	1991.5	271.723	499.867	81.749	2.646
1942.0	0.021	0.653	0.000	0.054	1967.0	36.984	87.089	3.840	0.162	1992.0	272.707	510.650	83.400	2.752
1942.5	0.023	0.752	0.000	0.054	1967.5	39.946	92.758	4.127	0.175	1992.5	273.407	513.057	83.900	2.862
1943.0	0.028	0.872	0.000	0.054	1968.0	43.310	99.106	4.414	0.187	1993.0	273.849	513.685	84.100	2.973
1943.5	0.032	0.992	0.007	0.054	1968.5	46.674	105.454	4.742	0.200	1993.5	274.056	518.117	84.300	3.087
1944.0	0.037	1.155	0.013	0.054	1969.0	50.573	112.509	5.071	0.212	1994.0	274.056	518.975	84.600	3.203
1944.5	0.041	1.318	0.028	0.054	1969.5	54.472	119.564	5.448	0.222	1994.5	273.874	525.793	84.700	3.322
1945.0	0.048	1.531	0.043	0.054	1970.0	58.886	127.258	5.825	0.233	1995.0	273.535	526.210	84.900	3.442
1945.5	0.055	1.745	0.059	0.054	1970.5	63.300	134.952	6.256	0.245	1995.5	272.953	526.540	85.200	3.566
1946.0	0.069	2.118	0.075	0.054	1971.0	68.113	143.160	6.687	0.255	1996.0	272.940	527.680	85.000	3.691
1946.5	0.082	2.491	0.093	0.054	1971.5	72.926	151.368	7.183	0.267	1996.5	271.267	530.450	84.700	3.819
1947.0	0.113	3.063	0.110	0.054	1972.0	78.336	160.293	7.680	0.281	1997.0	270.535	532.945	84.400	3.949
1947.5	0.143	3.636	0.131	0.054	1972.5	83.746	169.219	8.246	0.298	1997.5	269.227	534.040	84.100	4.081
1948.0	0.197	4.299	0.152	0.054	1973.0	89.927	179.091	8.813	0.317	1998.0	268.820	534.385	83.800	4.216
1948.5	0.251	4.963	0.174	0.054	1973.5	96.107	188.964	9.462	0.338	1998.5	267.230	537.227	83.400	4.353
1949.0	0.339	5.670	0.196	0.054	1974.0	102.860	199.607	10.112	0.362	1999.0	266.255	536.500	83.200	4.492
1949.5	0.428	6.377	0.222	0.054	1974.5	109.613	210.251	10.856	0.388	1999.5	264.400	537.300	82.800	4.634
1950.0	0.556	7.157	0.249	0.054	1975.0	115.310	220.405	11.600	0.416	2000.0	264.300	537.600	82.500	4.778
1950.5	0.684	7.937	0.279	0.054	1975.5	122.891	230.560	12.453	0.447	2000.5	263.883	539.250	82.200	nd
1951.0	0.859	8.790	0.308	0.054	1976.0	129.753	240.250	13.306	0.479					
1951.5	1.035	9.643	0.343	0.054	1976.5	136.000	249.941	14.283	0.515					
1952.0	1.288	10.524	0.377	0.054	1977.0	143.000	259.020	15.261	0.552					
1952.5	1.542	11.406	0.415	0.054	1977.5	147.650	268.100	16.380	0.592					
1953.0	1.887	12.394	0.454	0.054	1978.0	150.927	277.850	17.499	0.634					
1953.5	2.231	13.383	0.497	0.054	1978.5	157.509	288.133	18.781	0.678					
1954.0	2.655	14.499	0.540	0.055	1979.0	160.825	293.282	20.063	0.725					
1954.5	3.079	15.616	0.591	0.055	1979.5	163.692	296.325	21.531	0.774					

Table 11. Summary of average chlorofluorocarbon-based apparent recharge dates, ages[1], and uncertainties in water samples from wells and springs in Virginia, 1998-2000

[VAS, Virginia Aquifer Susceptibility study; CFC-11, (trichlorofluoromethane, $CFC1_3$); CFC-12, (dichlorodifluoromethane, CF_2Cl_2); CFC-113, (trichlorotrifluoroethane, $C_2F_3Cl_3$); ºC, degrees Celsius; Apparent age uncertainties are based on changes in age resulting from uncertainty in N_2-Ar recharge temperature of ±1ºC; C, contaminated, sample concentration higher than that of water in equilibrium with modern North American air; <, actual recharge date is older than date shown; >, actual age is older than age shown; Dates and ages are based on the North American air data of table 10; N/A, not applicable. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Average Model apparent recharge data			Average Apparent age and uncertainty		
			CFC-11	CFC-12	CFC-113	CFC-11 (years)	CFC-12 (years)	CFC-113 (years)
AP-01	7/10/2000	1045	C	C	C	C	C	C
AP-02	7/10/2000	1400	1960.0	1955.0	<1955.0	40.5 ± 1.8	45.5 ± 1.8	>45.5 ± 0.0
AP-03	7/20/2000	1045	1978.0	1988.0	1986.5	22.6 ± 1.3	12.6 ± 1.5	14.1 ± 0.5
AP-03d	7/20/2000	1050	N/A	N/A	N/A	N/A	N/A	N/A
AP-04	7/11/2000	1050	1952.5	1951.5	<1955.0	48.0 ± 1.8	49.0 ± 3.3	>45.5 ± 0.0
AP-05	7/12/2000	950	1955.0	1962.0	1966.5	45.5 ± 0.5	38.5 ± 1.5	34.0 ± 1.8
AP-06	7/13/2000	905	1956.5	1965.5	1968.5	44.0 ± 0.5	35.0 ± 0.3	32.0 ± 1.8
AP-07	7/13/2000	1445	1953.0	<1940.0	<1955.0	47.5 ± 1.0	>60.5 ± 0.0	>45.5 ± 0.0
AP-08	7/10/2000	950	1974.5	1981.5	1981.0	26.0 ± 0.5	19.0 ± 1.8	19.5 ± 0.8
AP-09	7/10/2000	1345	1963.0	1957.5	<1955.0	37.5 ± 1.0	43.0 ± 0.8	>45.5 ± 0.0
AP-10	7/11/2000	1115	1949.5	1950.0	<1955.0	51.0 ± 1.5	50.5 ± 1.3	>45.5 ± 0.0
AP-11	7/11/2000	1530	1952.5	1953.5	<1955.0	48.0 ± 0.8	47.0 ± 1.0	>45.5 ± 0.0
AP-12	7/12/2000	1140	1960.0	C	1972.5	40.5 ± 0.5	C	28.0 ± 0.8
AP-13	7/12/2000	1430	1954.5	1949.5	<1955.0	46.0 ± 0.3	51.0 ± 1.8	>45.5 ± 0.0
BR-01	7/19/1999	1100	1969.5	1976.0	1973.5	30.0 ± 1.8	23.5 ± 0.5	26.0 ± 0.5
BR-02	7/19/1999	1500	1986.0	C	1989.0	13.5 ± 1.3	C	10.5 ± 0.8
BR-03	7/20/1999	910	C	C	1990.5	C	C	9.1 ± 1.0
BR-04	7/20/1999	1425	1954.5	1978.0	<1955.0	45.1 ± 1.0	21.6 ± 0.8	>44.6 ± 0.0
BR-05	8/25/1999	1115	C	C	C	C	C	C
BR-06	9/13/1999	1715	1967.0	C	C	32.7 ± 1.3	C	C
BR-07	9/14/1999	940	1970.0	C	C	29.7 ± 0.5	C	C
BR-08	9/16/1999	940	C	C	C	C	C	C
BR-09	10/18/1999	1720	1959.0	1980.5	1987.0	40.8 ± 1.0	19.3 ± 1.0	12.8 ± 0.5
BR-10	10/26/1999	947	C	C	C	C	C	C
CP-01	6/23/1998	1338	<1945.0	<1940.0	<1955.0	>53.5 ± 0.0	>58.5 ± 0.0	>43.5 ± 0.0
CP-01d	6/23/1998	1342	N/A	N/A	N/A	N/A	N/A	N/A
CP-02	6/24/1998	1142	<1945.0	<1940.0	<1955.0	>53.5 ± 0.0	>58.5 ± 0.0	>43.5 ± 0.0
CP-03	6/25/1998	1231	<1945.0	<1940.0	<1955.0	>53.5 ± 0.0	>58.5 ± 0.0	>43.5 ± 0.0
CP-04	7/1/1998	1024	<1945.0	<1940.0	<1955.0	>53.5 ± 0.0	>58.5 ± 0.0	>43.5 ± 0.0
CP-05	7/6/1998	1213	<1945.0	<1940.0	<1955.0	>53.5 ± 0.0	>58.5 ± 0.0	>43.5 ± 0.0
CP-06	7/6/1998	1434	<1945.0	<1940.0	<1955.0	>53.5 ± 0.0	>58.5 ± 0.0	>43.5 ± 0.0
CP-07	7/7/1998	1158	<1945.0	<1940.0	<1955.0	>53.5 ± 0.0	>58.5 ± 0.0	>43.5 ± 0.0
CP-08	7/7/1998	1459	<1945.0	<1940.0	<1955.0	>53.5 ± 0.0	>58.5 ± 0.0	>43.5 ± 0.0
CP-09	7/8/1998	1159	<1945.0	<1940.0	<1955.0	>53.5 ± 0.0	>58.5 ± 0.0	>43.5 ± 0.0
CP-10	7/8/1998	1505	<1945.0	<1940.0	<1955.0	>53.5 ± 0.0	>58.5 ± 0.0	>43.5 ± 0.0
CP-11	7/9/1998	1121	<1945.0	<1940.0	<1955.0	>53.5 ± 0.0	>58.5 ± 0.0	>43.5 ± 0.0
CP-11b	7/9/1998	1126	N/A	N/A	N/A	N/A	N/A	N/A
CP-12	7/14/1998	1327	1952.0	1943.0	<1955.0	46.5 ± 2.0	55.5 ± 3.3	>43.5 ± 0.0
CP-13	7/15/1998	920	<1945.0	<1940.0	<1955.0	>53.5 ± 0.0	>58.5 ± 0.0	>43.5 ± 0.0

Table 11. Summary of average chlorofluorocarbon-based apparent recharge dates, ages[1], and uncertainties in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; CFC-11, (trichlorofluoromethane, $CFC1_3$); CFC-12, (dichlorodifluoromethane, CF_2Cl_2); CFC-113, (trichlorotrifluoroethane, $C_2F_3Cl_3$); ºC, degrees Celsius; Apparent age uncertainties are based on changes in age resulting from uncertainty in N_2-Ar recharge temperature of ±1ºC; C, contaminated, sample concentration higher than that of water in equilibrium with modern North American air; <, actual recharge date is older than date shown; >, actual age is older than age shown; Dates and ages are based on the North American air data of table 10; N/A, not applicable. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Average Model apparent recharge data			Average Apparent age and uncertainty		
			CFC-11	CFC-12	CFC-113	CFC-11 (years)	CFC-12 (years)	CFC-113 (years)
CP-14	7/15/1998	1220	1987.5	C	C	11.0 ± 1.0	C	C
CP-15	7/15/1998	1410	<1945.0	<1940.0	<1955.0	>53.5 ± 0.0	>58.5 ± 0.0	>43.5 ± 0.0
CP-16	7/16/1998	1008	<1945.0	<1940.0	<1955.0	>53.5 ± 0.0	>58.5 ± 0.0	>43.5 ± 0.0
CP-17	7/16/1998	1351	<1945.0	<1940.0	<1955.0	>53.5 ± 0.0	>58.5 ± 0.0	>43.5 ± 0.0
CP-18	7/27/1998	1117	1951.0	<1940.0	<1955.0	47.6 ± 1.3	>58.6 ± 0.0	>43.6 ± 0.0
CP-19	7/27/1998	1545	1948.0	<1940.0	<1955.0	50.6 ± 0.5	>58.6 ± 0.0	>43.6 ± 0.0
CP-20	7/28/1998	1102	<1945.0	<1940.0	<1955.0	>53.6 ± 0.0	>58.6 ± 0.0	>43.6 ± 0.0
CP-21	7/29/1998	1059	<1945.0	1964.5	<1955.0	>53.6 ± 0.0	34.1 ± 0.3	>43.6 ± 0.0
CP-22	7/30/1998	1048	<1945.0	<1940.0	<1955.0	>53.6 ± 0.0	>58.6 ± 0.0	>43.6 ± 0.0
CP-23	8/3/1998	1126	<1945.0	<1940.0	<1955.0	>53.6 ± 0.0	>58.6 ± 0.0	>43.6 ± 0.0
CP-23d	8/3/1998	1131	N/A	N/A	N/A	N/A	N/A	N/A
CP-24	8/4/1998	936	<1945.0	<1940.0	<1955.0	>53.6 ± 0.0	>58.6 ± 0.0	>43.6 ± 0.0
CP-25	8/4/1998	1440	1952.0	1946.5	1955.0	46.6 ± 1.0	52.1 ± 0.8	43.6 ± 1.3
CP-26	8/5/1998	1325	C	C	C	C	C	C
CP-27	8/6/1998	1001	<1945.0	<1940.0	<1955.0	>53.6 ± 0.0	>58.6 ± 0.0	>43.6 ± 0.0
CP-28	8/17/1998	1015	<1945.0	<1940.0	<1955.0	>53.6 ± 0.0	>58.6 ± 0.0	>43.6 ± 0.0
CP-29	8/17/1998	1340	<1945.0	<1940.0	<1955.0	>53.6 ± 0.0	>58.6 ± 0.0	>43.6 ± 0.0
CP-30	8/18/1998	1000	<1945.0	<1940.0	<1955.0	>53.6 ± 0.0	>58.6 ± 0.0	>43.6 ± 0.0
CP-31	8/19/1998	1620	<1945.0	<1940.0	<1955.0	>53.6 ± 0.0	>58.6 ± 0.0	>43.6 ± 0.0
CP-32	8/31/1998	1053	<1945.0	<1940.0	<1955.0	>53.7 ± 0.0	>58.7 ± 0.0	>43.7 ± 0.0
CP-33	8/31/1998	1453	<1945.0	<1940.0	<1955.0	>53.7 ± 0.0	>58.7 ± 0.0	>43.7 ± 0.0
CP-34	8/31/1998	1731	1956.0	1961.0	1972.0	42.7 ± 0.5	37.7 ± 0.8	26.7 ± 3.3
CP-34d	8/31/1998	1736	N/A	N/A	N/A	N/A	N/A	N/A
CP-35	9/1/1998	1038	<1945.0	<1940.0	<1955.0	>53.7 ± 0.0	>58.7 ± 0.0	>43.7 ± 0.0
CP-36	9/1/1998	1545	1950.0	1946.5	<1955.0	48.7 ± 0.5	52.2 ± 2.4	>43.7 ± 0.0
CP-37	9/2/1998	950	<1945.0	<1940.0	<1955.0	>53.7 ± 0.0	>58.7 ± 0.0	>43.7 ± 0.0
CP-38	9/2/1998	1259	<1945.0	<1940.0	<1955.0	>53.7 ± 0.0	>58.7 ± 0.0	>43.7 ± 0.0
CP-39	9/2/1998	1548	<1945.0	<1940.0	<1955.0	>53.7 ± 0.0	>58.7 ± 0.0	>43.7 ± 0.0
CP-40	9/3/1998	919	1951.0	1946.5	<1955.0	47.7 ± 0.8	52.2 ± 0.3	>43.7 ± 0.0
CP-41	9/10/1998	1115	<1945.0	<1940.0	<1955.0	>53.7 ± 0.0	>58.7 ± 0.0	>43.7 ± 0.0
CP-42	9/10/1998	1440	<1945.0	<1940.0	<1955.0	>53.7 ± 0.0	>58.7 ± 0.0	>43.7 ± 0.0
CP-43	10/1/1998	1135	<1945.0	<1940.0	<1955.0	>53.8 ± 0.0	>58.8 ± 0.0	>43.8 ± 0.0
CP-44	10/5/1998	1110	1948.0	<1940.0	<1955.0	50.8 ± 2.1	>58.8 ± 0.0	>43.8 ± 0.0
CP-45	10/5/1998	1505	<1945.0	1976.0	<1955.0	>53.8 ± 0.0	22.8 ± 0.8	>43.8 ± 0.0
CP-46	10/6/1998	1020	1976.0	1978.0	1984.0	22.8 ± 0.8	20.8 ± 1.8	14.8 ± 0.8
CP-47	10/6/1998	1430	1947.0	1945.0	<1955.0	51.8 ± 1.8	53.8 ± 3.6	>43.8 ± 0.0
CP-48	10/7/1998	1027	C	C	C	C	C	C
CP-49	10/27/1998	1025	1948.0	<1940.0	<1955.0	50.8 ± 0.5	>58.8 ± 0.0	>43.8 ± 0.0
CP-50	10/28/1998	1205	1989.0	C	C	9.8 ± 2.9	C	C
CP-51	11/4/1998	1220	<1945.0	<1940.0	<1955.0	>53.8 ± 0.0	>58.8 ± 0.0	>43.8 ± 0.0

Table 11. Summary of average chlorofluorocarbon-based apparent recharge dates, ages[1], and uncertainties in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; CFC-11, (trichlorofluoromethane, $CFC1_3$); CFC-12, (dichlorodifluoromethane, CF_2Cl_2); CFC-113, (trichlorotrifluoroethane, $C_2F_3Cl_3$); ºC, degrees Celsius; Apparent age uncertainties are based on changes in age resulting from uncertainty in N_2-Ar recharge temperature of ±1ºC; C, contaminated, sample concentration higher than that of water in equilibrium with modern North American air; <, actual recharge date is older than date shown; >, actual age is older than age shown; Dates and ages are based on the North American air data of table 10; N/A, not applicable. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Average Model apparent recharge data			Average Apparent age and uncertainty		
			CFC-11	CFC-12	CFC-113	CFC-11 (years)	CFC-12 (years)	CFC-113 (years)
CP-51d	11/4/1998	1225	N/A	N/A	N/A	N/A	N/A	N/A
PD-01	6/28/1999	1435	C	1980.0	1981.5	C	19.5 ± 1.8	18.0 ± 0.8
PD-02	6/29/1999	1530	1954.0	1973.0	1965.0	45.5 ± 1.0	26.5 ± 0.8	34.5 ± 1.3
PD-03	6/30/1999	1030	1963.0	1982.5	1971.5	36.5 ± 0.8	17.0 ± 2.5	28.0 ± 0.3
PD-04	6/30/1999	1500	1964.0	C	1973.5	35.5 ± 0.5	C	26.0 ± 0.5
PD-05	7/1/1999	1240	C	C	1972.5	C	C	27.0 ± 2.5
PD-06	8/23/1999	1245	1971.0	C	C	28.6 ± 0.5	C	C
PD-07	8/23/1999	1515	1962.0	1983.0	C	37.6 ± 0.5	16.6 ± 1.0	C
PD-08	8/30/1999	1100	1985.0	1988.5	C	14.7 ± 1.0	11.2 ± 1.3	C
PD-09	8/31/1999	1045	1959.0	1970.5	1987.5	40.7 ± 0.8	29.2 ± 0.3	12.2 ± 1.0
PD-10	9/1/1999	1045	C	C	C	C	C	C
PD-11	9/1/1999	1350	C	C	C	C	C	C
PD-12	9/1/1999	1720	1952.5	1975.0	1985.0	47.2 ± 0.5	24.7 ± 0.5	14.7 ± 1.5
PD-13	9/2/1999	1030	1984.5	1991.5	C	15.2 ± 1.3	8.2 ± 2.8	C
PD-14	9/2/1999	1230	1980.5	1991.5	1990.5	19.2 ± 1.0	8.2 ± 3.6	9.2 ± 1.5
PD-15	9/2/1999	1545	1963.0	1976.0	1988.0	36.7 ± 0.3	23.7 ± 0.5	11.7 ± 0.8
PD-15d	9/2/1999	1550	N/A	N/A	N/A	N/A	N/A	N/A
PD-16	9/13/1999	1035	1972.5	C	C	27.2 ± 0.5	C	C
PD-17	9/13/1999	1448	1972.5	1972.0	C	27.2 ± 1.5	27.7 ± 0.5	C
PD-18	10/18/1999	1030	1960.5	1978.5	C	39.3 ± 0.5	21.3 ± 1.0	C
PD-19	10/19/1999	1130	1974.5	1979.5	1987.5	25.3 ± 0.5	20.3 ± 1.3	12.3 ± 0.5
PD-20	10/19/1999	1545	1957.5	C	1984.0	42.3 ± 0.5	C	15.8 ± 1.0
PD-20b	10/20/1999	800	N/A	N/A	N/A	N/A	N/A	N/A
PD-21	10/25/1999	920	1952.0	1953.5	1981.0	47.8 ± 0.5	46.3 ± 0.3	18.8 ± 1.8
PD-22	10/25/1999	1240	1978.0	1977.0	1982.5	21.8 ± 1.0	22.8 ± 0.5	17.3 ± 0.5
PD-23	10/25/1999	1722	C	C	C	C	C	C
PD-24	10/26/1999	1324	C	C	C	C	C	C
PD-25	6/27/2000	1035	1986.0	C	1976.0	14.5 ± 1.0	C	24.5 ± 0.5
PD-26	6/27/2000	1500	1972.0	1987.0	1980.5	28.5 ± 0.5	13.5 ± 1.5	20.0 ± 0.5
PD-27	6/28/2000	920	1963.5	1975.0	1975.0	37.0 ± 0.3	25.5 ± 1.8	25.5 ± 3.5
PD-28	6/28/2000	1440	1979.5	1973.0	1972.0	21.0 ± 2.3	27.5 ± 1.0	28.5 ± 0.5
PD-29	6/29/2000	1130	1952.0	C	<1955.0	48.5 ± 1.3	C	>45.5 ± 0.0
PD-30	6/29/2000	1540	1960.0	1968.0	1973.0	40.5 ± 0.3	32.5 ± 0.5	27.5 ± 0.5
VB-01	5/13/1999	1615	1951.0	1946.5	<1955.0	48.4 ± 0.0	52.9 ± 0.3	>44.4 ± 0.0
VB-02	5/14/1999	1115	1951.0	1941.5	<1955.0	48.4 ± 2.3	57.9 ± 2.3	>44.4 ± 0.0
VB-03	5/10/1999	1830	1949.5	1970.5	<1955.0	49.9 ± 1.0	28.9 ± 1.0	>44.4 ± 0.0
VB-04	5/12/1999	1230	1949.0	1945.5	<1955.0	50.4 ± 0.3	53.9 ± 3.4	>44.4 ± 0.0
VB-05	8/14/2000	1415	1947.0	<1940.0	<1955.0	53.6 ± 2.0	>60.6 ± 0.0	>45.6 ± 0.0
VB-05b	8/14/2000	1410	N/A	N/A	N/A	N/A	N/A	N/A
VB-06	8/11/2000	1000	1948.0	1948.0	<1955.0	52.6 ± 0.5	52.6 ± 0.8	>45.6 ± 0.0

Table 11. Summary of average chlorofluorocarbon-based apparent recharge dates, ages[1], and uncertainties in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; CFC-11, (trichlorofluoromethane, $CFCl_3$); CFC-12, (dichlorodifluoromethane, CF_2Cl_2); CFC-113, (trichlorotrifluoroethane, $C_2F_3Cl_3$); ºC, degrees Celsius; Apparent age uncertainties are based on changes in age resulting from uncertainty in N_2-Ar recharge temperature of ±1ºC; C, contaminated, sample concentration higher than that of water in equilibrium with modern North American air; <, actual recharge date is older than date shown; >, actual age is older than age shown; Dates and ages are based on the North American air data of table 10; N/A, not applicable. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Average Model apparent recharge data			Average Apparent age and uncertainty		
			CFC-11	CFC-12	CFC-113	CFC-11 (years)	CFC-12 (years)	CFC-113 (years)
VB-07	8/10/2000	1110	1965.0	1955.0	1976.0	35.6 ± 0.8	45.6 ± 1.5	24.6 ± 1.0
VB-08	8/9/2000	1130	<1945.0	1951.5	1968.0	>55.6 ± 0.0	49.1 ± 0.8	32.6 ± 1.5
VB-09	8/16/2000	1520	1952.5	1950.5	1965.5	48.1 ± 5.5	50.1 ± 2.0	35.1 ± 1.3
VB-10	8/17/2000	1045	1949.0	1948.5	<1955.0	51.6 ± 2.8	52.1 ± 2.0	>45.6 ± 0.0
VB-11	8/16/2000	945	1958.5	1951.5	1966.5	42.1 ± 6.7	49.1 ± 3.0	34.1 ± 5.6
VB-12	8/15/2000	1115	1948.5	1954.5	1973.5	52.1 ± 1.0	46.1 ± 0.5	27.1 ± 0.5
VB-13	8/8/2000	1225	1952.0	<1940.0	<1955.0	48.6 ± 0.5	>60.6 ± 0.0	>45.6 ± 0.0
VB-14	8/7/2000	1745	<1945.0	<1940.0	<1955.0	>55.6 ± 0.0	>60.6 ± 0.0	>45.6 ± 0.0
VB-14d	8/7/2000	1750	N/A	N/A	N/A	N/A	N/A	N/A
VR-01	7/6/1999	1230	1952.5	<1940.0	1960.0	47.0 ± 1.5	>59.5 ± 0.0	39.5 ± 5.5
VR-02	7/6/1999	1615	1973.5	1973.0	1978.5	26.0 ± 0.3	26.5 ± 1.8	21.0 ± 2.0
VR-03	7/7/1999	1035	1985.5	1991.5	C	14.0 ± 1.0	8.0 ± 3.3	C
VR-03d	7/7/1999	1040	N/A	N/A	N/A	N/A	N/A	N/A
VR-04	7/7/1999	1400	1980.0	1979.5	C	19.5 ± 1.0	20.0 ± 1.3	C
VR-05	7/8/1999	1015	1985.5	C	C	14.0 ± 1.0	C	C
VR-06	7/8/1999	1620	1975.5	1988.5	C	24.0 ± 0.8	11.0 ± 1.5	C
VR-07	7/8/1999	1820	1970.0	1977.0	C	29.5 ± 0.3	22.5 ± 1.0	C
VR-08	7/9/1999	1015	1965.5	1972.5	C	34.0 ± 0.5	27.0 ± 0.3	C
VR-09	7/9/1999	1300	1970.5	1974.0	1978.5	29.0 ± 0.3	25.5 ± 1.3	21.0 ± 0.5
VR-10	7/9/1999	1500	1976.5	1984.0	1978.5	23.0 ± 0.8	15.5 ± 1.0	21.0 ± 0.5
VR-11	7/9/1999	1645	1950.5	1949.5	1975.0	49.0 ± 0.3	50.0 ± 3.5	24.5 ± 1.3
VR-12	7/21/1999	945	1975.0	C	1976.0	24.6 ± 0.3	C	23.6 ± 0.5
VR-13	7/21/1999	1250	C	C	C	C	C	C
VR-14	7/22/1999	1200	1965.0	1965.0	C	34.6 ± 0.5	34.6 ± 0.8	C
VR-15	8/10/1999	1400	1951.0	1949.0	C	48.6 ± 0.8	50.6 ± 1.3	C
VR-15bt	8/10/1999	1405	N/A	N/A	N/A	N/A	N/A	N/A
VR-16	8/11/1999	1330	1954.0	1958.5	C	45.6 ± 0.3	41.1 ± 0.3	C
VR-17	8/11/1999	1630	1986.0	1996.5	C	13.6 ± 1.0	3.1 ± 4.2	C
VR-18	8/12/1999	1130	1957.5	1967.0	C	42.1 ± 0.5	32.6 ± 0.5	C
VR-19	8/24/1999	1050	1977.5	C	1990.0	22.1 ± 1.3	C	9.6 ± 1.3
VR-20	8/24/1999	1315	1983.5	1986.5	C	16.1 ± 1.3	13.1 ± 1.0	C
VR-21	8/25/1999	1530	1970.5	1975.5	C	29.1 ± 0.5	24.1 ± 1.0	C
VR-22	8/26/1999	925	1974.0	1975.5	C	25.7 ± 0.5	24.2 ± 0.5	C
VR-23	8/26/1999	1400	1975.0	C	C	24.7 ± 0.3	C	C
VR-24	10/27/1999	925	1952.5	1950.0	1971.5	47.3 ± 2.3	49.8 ± 0.5	28.3 ± 1.8
VR-25	10/27/1999	1340	1955.5	1962.0	1976.5	44.3 ± 0.5	37.8 ± 0.5	23.3 ± 1.3
VR-26	10/28/1999	1010	1979.5	1982.5	1985.5	20.3 ± 1.0	17.3 ± 1.0	14.3 ± 0.5
VR-27	10/28/1999	1345	1976.5	1981.0	1984.5	23.3 ± 0.5	18.8 ± 1.0	15.3 ± 0.5
VR-28	7/12/2000	1415	1954.5	1959.5	1961.0	46.0 ± 0.3	41.0 ± 0.3	39.5 ± 1.5
VR-29	7/13/2000	1108	1954.0	1952.5	<1955.0	46.5 ± 0.3	48.0 ± 0.8	>45.5 ± 0.0

Table 11. Summary of average chlorofluorocarbon-based apparent recharge dates, ages[1], and uncertainties in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; CFC-11, (trichlorofluoromethane, $CFC1_3$); CFC-12, (dichlorodifluoromethane, CF_2Cl_2); CFC-113, (trichlorotrifluoroethane, $C_2F_3Cl_3$); ºC, degrees Celsius; Apparent age uncertainties are based on changes in age resulting from uncertainty in N_2-Ar recharge temperature of ±1ºC; C, contaminated, sample concentration higher than that of water in equilibrium with modern North American air; <, actual recharge date is older than date shown; >, actual age is older than age shown; Dates and ages are based on the North American air data of table 10; N/A, not applicable. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Average Model apparent recharge data			Average Apparent age and uncertainty		
			CFC-11	CFC-12	CFC-113	CFC-11 (years)	CFC-12 (years)	CFC-113 (years)
VR-30	7/13/2000	1415	1966.0	1969.0	1975.5	34.5 ± 0.3	31.5 ± 0.5	25.0 ± 0.8
VR-31	7/17/2000	950	1955.5	1952.0	<1955.0	45.0 ± 0.5	48.5 ± 1.8	>45.5 ± 0.0
VR-32	7/17/2000	1321	1958.5	1969.0	1965.0	42.0 ± 0.8	31.5 ± 0.5	35.5 ± 2.5
VR-33	7/18/2000	1030	1983.5	C	1989.0	17.0 ± 1.3	C	11.5 ± 1.5
VR-34	7/18/2000	1400	1966.0	1975.5	1983.0	34.5 ± 0.5	25.0 ± 1.0	17.5 ± 1.0
VR-35	7/19/2000	915	1949.5	1948.5	<1955.0	51.1 ± 0.8	52.1 ± 2.5	>45.6 ± 0.0
VR-35b	7/19/2000	1000	N/A	N/A	N/A	N/A	N/A	N/A
VR-36	7/20/2000	1430	1984.5	1989.0	1988.0	16.1 ± 1.0	11.6 ± 2.0	12.6 ± 0.5
VR-37	7/17/2000	950	1970.5	1971.5	1977.5	30.0 ± 0.5	29.0 ± 0.5	23.0 ± 1.3
VR-37d	7/17/2000	955	N/A	N/A	N/A	N/A	N/A	N/A
VR-38	7/18/2000	915	1975.0	1981.0	1984.0	25.5 ± 0.5	19.5 ± 0.8	16.5 ± 0.8
VR-39	7/18/2000	1330	1969.0	1968.0	1974.0	31.5 ± 0.5	32.5 ± 0.8	26.5 ± 0.5
VR-40	7/19/2000	925	C	1964.0	1975.5	C	36.6 ± 0.5	25.1 ± 0.5
VR-41	7/19/2000	1125	1964.0	1962.5	1977.5	36.6 ± 0.3	38.1 ± 0.5	23.1 ± 0.5
VR-42	7/20/2000	1200	1984.0	C	1987.0	16.6 ± 1.0	C	13.6 ± 0.5
VR-42bt	7/20/2000	1205	N/A	N/A	N/A	N/A	N/A	N/A
VR-43	7/20/2000	1740	1963.0	1968.0	1973.0	37.6 ± 0.5	32.6 ± 0.5	27.6 ± 1.0
VR-44	7/20/2000	900	1988.0	C	1985.0	12.6 ± 1.5	C	15.6 ± 0.5
VR-45	7/25/2000	920	1972.5	1972.0	1974.0	28.1 ± 0.5	28.6 ± 0.5	26.6 ± 0.3
VR-46	7/25/2000	1310	1971.0	1971.5	1979.5	29.6 ± 0.5	29.1 ± 0.5	21.1 ± 0.8
VR-47	7/26/2000	1015	1987.0	1990.5	C	13.6 ± 1.0	10.1 ± 2.0	C
VTDW-01	9/16/1999	1505	1980.0	1991.0	C	19.7 ± 5.0	8.7 ± 2.8	C
VTDW-03A	7/15/2000	1300	1969.0	1971.0	1978.0	31.5 ± 1.5	29.5 ± 1.3	22.5 ± 1.8
VTDW-03B	7/15/2000	1700	1970.0	1972.5	1979.0	30.5 ± 1.0	28.0 ± 1.0	21.5 ± 1.0
VTDW-07A	7/14/2000	1430	1961.0	1972.0	1973.0	39.5 ± 0.5	28.5 ± 0.5	27.5 ± 1.5
VTDW-07B	7/14/2000	1610	1967.5	1970.5	1976.5	33.0 ± 0.3	30.0 ± 0.5	24.0 ± 1.0
VTDW-08	9/16/1999	1800	C	C	C	C	C	C

[1] Apparent chlorofluorocarbon recharge dates and ages were calculated using the chlorofluorocarbon program version 1.2 (Microsoft Excel) by E. Busenberg and L.N. Plummer of the U.S. Geological Survey.

Table 12. Summary of averaged sulfur hexafluoride data[1] in water samples from wells and springs in Virginia, 1998-2000

[VAS, Virginia Aquifer Susceptibility study; n, number of samples averaged; SF_6, sulfur hexafluoride; fmol/L, femtomoles per liter; ºC, degrees Celsius; pptv, parts per trillion by volume; cc/L, cubic centimeters per liter; Ex Air, excess air; C, contaminated, sample SF_6 concentration greater than that of water in equilibrium with modern air; HC, highly contaminated; <, actual recharge date is older than date shown; >, actual age is older than age shown; Meas. st. dev., standard deviation of measured values; Rtemp, recharge temperature; Apparent age uncertainties are based on standard deviation of measured ages, changes in recharge temperature (±1ºC) and excess air (±1 cc/L); Apparent recharge dates and ages are based on the North American air data of table 10; N/A, not applicable; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	n	SF_6 concentration in water (fmol/L)	Recharge Temperature (ºC)	SF_6 partial pressure (pptv)[1]	Excess air (cc/L)	Model SF_6 partial pressure remove Ex Air (pptv)[2]	Model SF_6 apparent recharge date (years)	Model SF_6 apparent age (years)	Model SF_6 apparent age uncertainity		
											Meas. st. dev. (years)	Rtemp ±1ºC (years)	Excess air ±1 cc/L (years)
AP-01	7/10/2000	1045	2	0.040	13.0	0.12	0.0	0.12	1964.5	36.0	2.0	1.5	1.8
AP-02	7/10/2000	1400	2	0.062	10.1	0.16	3.6	0.11	1964.5	36.0	2.0	1.3	1.5
AP-03	7/20/2000	1045	2	3.210	14.0	9.84	3.9	6.93	C	C	nd	nd	nd
AP-03d	7/20/2000	1050	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AP-04	7/11/2000	1050	2	0.020	12.3	0.06	-1.2	0.07	1960.0	40.5	nd	0.5	2.5
AP-05	7/12/2000	950	2	0.349	15.2	1.13	-0.2	1.16	1982.5	18.0	0.0	0.5	1.0
AP-06	7/13/2000	905	2	0.673	9.8	1.79	2.2	1.41	1984.5	16.0	0.3	0.3	0.8
AP-07	7/13/2000	1445	1	0.053	12.3	0.16	2.8	0.12	1964.5	36.0	nd	0.3	0.5
AP-08	7/10/2000	950	2	0.695	11.6	2.01	5.4	1.18	1982.5	18.0	0.3	0.3	0.8
AP-09	7/10/2000	1345	2	0.631	13.7	1.91	5.6	1.06	1982.0	18.5	0.3	0.3	1.3
AP-10	7/11/2000	1115	2	0.173	12.0	0.49	0.0	0.49	1976.0	24.5	0.8	0.5	1.0
AP-11	7/11/2000	1530	1	0.087	12.0	0.25	0.0	0.25	1970.5	30.0	nd	0.5	1.3
AP-12	7/12/2000	1140	2	0.631	13.7	1.91	-0.2	1.96	1988.0	12.5	0.3	0.3	1.3
AP-13	7/12/2000	1430	2	0.035	9.4	0.09	3.2	0.06	1959.5	41.0	1.5	1.3	1.8
BR-01	7/19/1999	1100	1	10.631	13.5	30.87	0.0	30.87	C	C	nd	nd	nd
BR-02	7/19/1999	1500	1	1.836	13.0	5.21	4.2	nd	C	C	nd	nd	nd
BR-03	7/20/1999	910	2	1.399	9.2	3.77	1.1	3.34	1994.5	5.1	0.3	0.5	1.3
BR-04	7/20/1999	1425	1	1.057	10.6	2.79	5.4	1.70	1986.5	13.1	nd	0.3	0.8
BR-05	8/25/1999	1115	3	0.566	9.8	1.44	6.6	0.81	1979.5	20.1	2.8	2.3	2.5
BR-06	9/13/1999	1715	3	2.522	10.7	6.54	2.1	nd	C	C	nd	nd	nd
BR-07	9/14/1999	940	2	11.723	19.9	42.21	9.2	34.11	C	C	nd	nd	nd
BR-08	9/16/1999	940	3	1.475	12.9	4.46	0.6	4.15	1997.5	2.2	0.5	0.5	1.8
BR-09	10/18/1999	1720	2	3.075	11.5	8.30	8.8	2.45	1990.5	9.3	0.0	0.5	nd
BR-10	10/26/1999	947	4	1.631	13.1	4.62	0.0	4.62	1999.0	0.8	0.8	nd	nd
CP-01	6/23/1998	1338	2	0.485	9.1	1.16	2.6	0.91	1980.5	18.0	0.5	0.5	1.0
CP-01d	6/23/1998	1342	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 12. Summary of averaged sulfur hexafluoride data[1] in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; n, number of samples averaged; SF_6, sulfur hexafluoride; fmol/L, femtomoles per liter; ºC, degrees Celsius; pptv, parts per trillion by volume; cc/L, cubic centimeters per liter; Ex Air, excess air; C, contaminated, sample SF_6 concentration greater than that of water in equilibrium with modern air; HC, highly contaminated; <, actual recharge date is older than date shown; >, actual age is older than age shown; Meas. st. dev., standard deviation of measured values; Rtemp, recharge temperature; Apparent age uncertainties are based on standard deviation of measured ages, changes in recharge temperature (±1ºC) and excess air (±1 cc/L); Apparent recharge dates and ages are based on the North American air data of table 10; N/A, not applicable; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	n	SF_6 concentration in water (fmol/L)	Recharge Temperature (ºC)	SF_6 partial pressure (pptv)[1]	Excess air (cc/L)	Model SF_6 partial pressure remove Ex Air (pptv)[2]	Model SF_6 apparent recharge date (years)	Model SF_6 apparent age (years)	Model SF_6 apparent age uncertainity: Meas. st. dev. (years)	Rtemp ±1ºC (years)	Excess air ±1 cc/L (years)
CP-02	6/24/1998	1142	2	0.130	13.1	0.36	3.3	0.26	1971.0	27.5	0.8	0.8	1.0
CP-03	6/25/1998	1231	2	0.059	9.7	0.14	3.2	0.11	1964.0	34.5	0.8	0.5	0.8
CP-04	7/1/1998	1024	2	0.107	5.2	0.21	2.8	0.17	1967.0	31.5	0.0	0.3	0.5
CP-05	7/6/1998	1213	2	0.200	5.4	0.40	3.5	0.31	1972.5	26.0	0.0	0.5	0.5
CP-06	7/6/1998	1434	2	0.162	8.6	0.38	3.2	0.28	1972.0	26.5	0.3	0.3	0.8
CP-07	7/7/1998	1158	1	0.063	4.6	0.12	2.9	0.10	1963.5	35.0	nd	0.5	0.5
CP-08	7/7/1998	1459	1	0.146	6.0	0.30	2.9	0.24	1970.0	28.5	nd	0.5	1.0
CP-09	7/8/1998	1159	1	0.121	10.7	0.31	4.3	0.21	1968.5	30.0	nd	0.3	0.8
CP-10	7/8/1998	1505	1	0.120	8.1	0.27	3.2	0.21	1968.5	30.0	nd	0.3	0.8
CP-11	7/9/1998	1121	1	0.071	9.2	0.17	2.7	0.13	1965.5	33.0	nd	0.3	0.5
CP-11b	7/9/1998	1126	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CP-12	7/14/1998	1327	1	0.037	12.8	0.10	3.2	0.07	1961.0	37.5	nd	0.5	1.0
CP-13	7/15/1998	920	2	0.023	8.8	0.05	3.0	0.04	<1952.0	>46.5	nd	0.0	0.0
CP-14	7/15/1998	1220	1	0.517	16.5	1.63	2.4	1.22	1983.0	15.5	nd	0.3	1.0
CP-15	7/15/1998	1410	1	0.166	8.4	0.38	2.9	0.30	1972.0	26.5	nd	0.3	0.8
CP-16	7/16/1998	1008	1	0.048	10.4	0.12	2.6	0.09	1963.0	35.5	nd	0.3	0.8
CP-17	7/16/1998	1351	1	0.285	12.4	0.77	2.3	0.61	1977.5	21.0	nd	0.3	0.8
CP-18	7/27/1998	1117	1	0.191	10.2	0.48	2.4	0.38	1974.0	24.6	nd	0.3	0.5
CP-19	7/27/1998	1545	2	0.139	11.6	0.37	2.6	0.28	1972.0	26.6	0.3	0.3	0.8
CP-20	7/28/1998	1102	1	0.108	8.3	0.25	3.3	0.19	1967.5	31.1	nd	0.3	0.8
CP-21	7/29/1998	1059	1	0.168	14.9	0.50	4.8	0.30	1972.5	26.1	nd	0.0	0.8
CP-22	7/30/1998	1048	2	0.026	11.7	0.07	2.8	0.05	<1952.0	>46.6	2.0	1.4	2.3
CP-23	8/3/1998	1126	2	0.019	6.9	0.04	2.8	0.03	<1952.0	>46.6	nd	0.0	0.0
CP-23d	8/3/1998	1131	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CP-24	8/4/1998	936	1	0.122	9.3	0.29	3.0	0.22	1969.5	29.1	nd	0.3	0.8
CP-25	8/4/1998	1440	1	0.167	9.9	0.41	2.5	0.33	1973.0	25.6	nd	0.3	0.8

Table 12. Summary of averaged sulfur hexafluoride data[1] in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; n, number of samples averaged; SF_6, sulfur hexafluoride; fmol/L, femtomoles per liter; ºC, degrees Celsius; pptv, parts per trillion by volume; cc/L, cubic centimeters per liter; Ex Air, excess air; C, contaminated, sample SF_6 concentration greater than that of water in equilibrium with modern air; HC, highly contaminated; <, actual recharge date is older than date shown; >, actual age is older than age shown; Meas. st. dev., standard deviation of measured values; Rtemp, recharge temperature; Apparent age uncertainties are based on standard deviation of measured ages, changes in recharge temperature (±1ºC) and excess air (±1 cc/L); Apparent recharge dates and ages are based on the North American air data of table 10; N/A, not applicable; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	n	SF_6 concentration in water (fmol/L)	Recharge Temperature (ºC)	SF_6 partial pressure (pptv)[1]	Excess air (cc/L)	Model SF_6 partial pressure remove Ex Air (pptv)[2]	Model SF_6 apparent recharge date (years)	Model SF_6 apparent age (years)	Model SF_6 apparent age uncertainity		
											Meas. st. dev. (years)	Rtemp ±1ºC (years)	Excess air ±1 cc/L (years)
CP-26	8/5/1998	1325	1	0.948	13.3	2.67	2.0	2.15	1988.5	10.1	nd	0.3	1.3
CP-27	8/6/1998	1001	1	0.104	8.9	0.25	2.5	0.20	1968.0	30.6	nd	0.3	0.8
CP-28	8/17/1998	1015	1	0.460	9.8	1.13	7.1	0.62	1977.5	21.1	nd	0.0	1.0
CP-29	8/17/1998	1340	1	0.066	7.6	0.15	2.8	0.11	1964.5	34.1	nd	0.0	0.5
CP-30	8/18/1998	1000	2	0.024	3.8	0.04	2.2	0.04	<1952.0	>46.6	0.0	0.0	0.0
CP-31	8/19/1998	1620	1	0.062	7.0	0.14	2.0	0.11	1964.5	34.1	nd	0.5	0.5
CP-32	8/31/1998	1053	2	0.025	4.9	0.05	3.9	0.04	<1952.0	>46.7	nd	0.0	0.0
CP-33	8/31/1998	1453	2	0.037	9.6	0.09	2.5	0.07	1960.5	38.2	1.0	0.8	1.3
CP-34	8/31/1998	1731	2	0.231	15.3	0.70	6.1	0.36	1973.5	25.2	0.3	0.3	3.3
CP-34d	8/31/1998	1736	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CP-35	9/1/1998	1038	2	0.070	7.5	0.16	2.1	0.13	1965.5	33.2	0.0	0.3	0.5
CP-36	9/1/1998	1545	2	0.060	7.0	0.13	2.3	0.11	1964.0	34.7	2.0	1.3	1.8
CP-37	9/2/1998	950	2	0.077	6.5	0.16	2.8	0.13	1965.5	33.2	0.8	0.8	0.8
CP-38	9/2/1998	1259	2	0.122	5.2	0.24	3.2	0.19	1968.0	30.7	0.0	0.3	0.5
CP-39	9/2/1998	1548	2	0.036	9.1	0.09	2.4	0.07	1960.0	38.7	1.8	1.3	1.8
CP-40	9/3/1998	919	2	0.038	6.0	0.08	3.0	0.06	1958.5	40.2	2.3	2.0	2.3
CP-41	9/10/1998	1115	2	0.096	7.1	0.21	2.8	0.16	1967.0	31.7	0.3	0.3	0.5
CP-42	9/10/1998	1440	2	0.064	7.2	0.14	2.7	0.11	1964.5	34.2	1.5	1.3	1.3
CP-43	10/1/1998	1135	2	0.050	5.9	0.10	3.0	0.08	1962.0	36.8	0.5	0.5	1.0
CP-44	10/5/1998	1110	2	0.117	6.9	0.25	3.3	0.19	1968.0	30.8	0.0	0.3	0.5
CP-45	10/5/1998	1505	2	1.188	13.1	3.31	3.8	2.25	1989.5	9.3	0.3	0.3	0.8
CP-46	10/6/1998	1020	2	0.376	13.2	1.06	2.7	0.79	1979.5	19.3	0.3	0.3	0.8
CP-47	10/6/1998	1430	2	0.051	8.1	0.12	2.4	0.09	1963.0	35.8	0.3	0.3	0.8
CP-48	10/7/1998	1027	2	1.898	13.2	5.33	0.0	nd	C	C	nd	nd	nd
CP-49	10/27/1998	1025	2	0.038	11.3	0.10	1.4	0.09	1962.5	36.3	2.0	1.5	2.0
CP-50	10/28/1998	1205	2	1.223	13.3	3.45	0.1	3.40	1994.5	4.3	0.0	0.5	1.5

Table 12. Summary of averaged sulfur hexafluoride data[1] in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; n, number of samples averaged; SF_6, sulfur hexafluoride; fmol/L, femtomoles per liter; ºC, degrees Celsius; pptv, parts per trillion by volume; cc/L, cubic centimeters per liter; Ex Air, excess air; C, contaminated, sample SF_6 concentration greater than that of water in equilibrium with modern air; HC, highly contaminated; <, actual recharge date is older than date shown; >, actual age is older than age shown; Meas. st. dev., standard deviation of measured values; Rtemp, recharge temperature; Apparent age uncertainties are based on standard deviation of measured ages, changes in recharge temperature (±1ºC) and excess air (±1 cc/L); Apparent recharge dates and ages are based on the North American air data of table 10; N/A, not applicable; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	n	SF_6 concentration in water (fmol/L)	Recharge Temperature (ºC)	SF_6 partial pressure (pptv)[1]	Excess air (cc/L)	Model SF_6 partial pressure remove Ex Air (pptv)[2]	Model SF_6 apparent recharge date (years)	Model SF_6 apparent age (years)	Model SF_6 apparent age uncertainity		
											Meas. st. dev. (years)	Rtemp ±1ºC (years)	Excess air ±1 cc/L (years)
CP-51	11/4/1998	1220	2	0.062	8.9	0.15	2.4	0.12	1964.5	34.3	0.8	0.5	0.8
CP-51d	11/4/1998	1225	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PD-01	6/28/1999	1435	2	15.359	10.0	38.28	3.8	35.95	C	C	nd	nd	nd
PD-02	6/29/1999	1530	2	1.380	13.0	3.93	3.0	2.85	1992.0	7.5	0.5	0.5	1.3
PD-03	6/30/1999	1030	1	0.563	14.6	1.69	3.9	1.12	1982.0	17.5	nd	0.3	0.8
PD-04	6/30/1999	1500	1	11.167	12.9	31.78	3.7	29.22	Cont.	C	nd	nd	nd
PD-05	7/1/1999	1240	1	4.928	14.2	14.57	5.7	10.45	Cont.	C	nd	nd	nd
PD-06	8/23/1999	1245	2	1.362	6.6	2.93	8.1	1.60	1985.5	14.1	0.3	0.3	1.0
PD-07	8/23/1999	1515	4	1.108	12.0	3.00	7.7	0.98	1981.0	18.6	0.0	2.3	nd
PD-08	8/30/1999	1100	2	1,439.655	13.5	4,132.97	0.7	4,123.43	HC	HC	nd	nd	nd
PD-09	8/31/1999	1045	3	1.281	9.9	3.15	3.2	2.33	1989.5	10.2	3.0	2.5	2.5
PD-10	9/1/1999	1045	4	0.728	14.9	2.21	2.4	1.67	1986.0	13.7	1.0	1.0	1.5
PD-11	9/1/1999	1350	2	1.682	14.3	5.00	4.0	nd	C	C	nd	nd	nd
PD-12	9/1/1999	1720	2	4.450	13.7	12.79	3.0	10.66	C	C	nd	nd	nd
PD-13	9/2/1999	1030	2	0.804	11.2	2.11	2.4	1.64	1986.0	13.7	0.3	0.3	0.8
PD-14	9/2/1999	1230	1	1.165	11.3	3.06	3.6	2.16	1989.0	10.7	nd	0.3	0.8
PD-15	9/2/1999	1545	2	9.215	14.1	26.98	3.3	24.60	C	C	nd	nd	nd
PD-15d	9/2/1999	1550	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PD-16	9/13/1999	1035	4	671.085	9.2	1,610.93	5.9	1,547.37	HC	HC	nd	nd	nd
PD-17	9/13/1999	1448	2	0.700	9.4	1.69	5.4	1.07	1982.0	17.7	1.0	0.8	1.0
PD-18	10/18/1999	1030	2	1.373	11.5	3.63	6.4	2.03	1988.0	11.8	0.3	0.3	1.5
PD-19	10/19/1999	1130	2	0.851	10.6	2.18	3.0	1.62	1985.5	14.3	0.3	0.3	0.8
PD-20	10/19/1999	1545	2	0.655	10.8	1.69	7.0	0.89	1980.5	19.3	0.3	0.3	1.8
PD-20b	10/20/1999	800	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PD-21	10/25/1999	920	2	0.124	11.5	0.33	1.8	0.27	1971.5	28.3	0.5	0.5	1.0
PD-22	10/25/1999	1240	2	0.631	11.0	1.64	0.8	1.51	1985.0	14.8	0.0	0.5	1.0

Table 12. Summary of averaged sulfur hexafluoride data[1] in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; n, number of samples averaged; SF_6, sulfur hexafluoride; fmol/L, femtomoles per liter; ºC, degrees Celsius; pptv, parts per trillion by volume; cc/L, cubic centimeters per liter; Ex Air, excess air; C, contaminated, sample SF_6 concentration greater than that of water in equilibrium with modern air; HC, highly contaminated; <, actual recharge date is older than date shown; >, actual age is older than age shown; Meas. st. dev., standard deviation of measured values; Rtemp, recharge temperature; Apparent age uncertainties are based on standard deviation of measured ages, changes in recharge temperature (±1ºC) and excess air (±1 cc/L); Apparent recharge dates and ages are based on the North American air data of table 10; N/A, not applicable; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	n	SF_6 concentration in water (fmol/L)	Recharge Temperature (ºC)	SF_6 partial pressure (pptv)[1]	Excess air (cc/L)	Model SF_6 partial pressure remove Ex Air (pptv)[2]	Model SF_6 apparent recharge date (years)	Model SF_6 apparent age (years)	Model SF_6 apparent age uncertainity		
											Meas. st. dev. (years)	Rtemp ±1ºC (years)	Excess air ±1 cc/L (years)
PD-23	10/25/1999	1722	2	10.354	9.3	24.87	6.2	21.22	C	C	nd	nd	nd
PD-24	10/26/1999	1324	2	7.305	11.0	18.93	2.7	17.22	C	C	nd	nd	nd
PD-25	6/27/2000	1035	2	0.371	12.0	1.03	2.9	0.76	1979.0	21.5	0.0	0.3	0.5
PD-26	6/27/2000	1500	3	2.071	8.8	4.99	0.8	nd	C	C	nd	nd	nd
PD-27	6/28/2000	920	2	4.113	10.1	10.29	7.3	5.79	C	C	nd	nd	nd
PD-28	6/28/2000	1440	2	2.261	12.8	6.29	2.7	4.69	1999.5	1.0	0.5	0.5	nd
PD-29	6/29/2000	1130	2	0.432	17.0	1.40	5.9	0.68	1978.5	22.0	0.3	0.3	4.6
PD-30	6/29/2000	1540	2	0.451	9.3	1.08	5.1	0.70	1978.5	22.0	0.0	0.0	0.5
VB-01	5/13/1999	1615	2	0.019	10.8	0.05	2.7	0.04	<1952.0	>47.4	0.0	0.0	0.0
VB-02	5/14/1999	1115	2	0.074	15.0	0.22	4.7	0.14	1965.5	33.9	1.0	0.5	1.0
VB-03	5/10/1999	1830	2	0.085	14.0	0.25	5.3	0.15	1966.0	33.4	nd	0.0	0.5
VB-04	5/12/1999	1230	2	0.026	13.4	0.07	3.3	0.05	<1952.0	>47.4	nd	0.0	2.0
VB-05	8/14/2000	1415	2	0.103	11.2	0.26	3.2	0.19	1968.0	32.6	2.3	2.0	2.0
VB-05b	8/14/2000	1410	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
VB-06	8/11/2000	1000	2	0.163	10.3	0.40	4.6	0.27	1971.5	29.1	1.8	1.5	1.5
VB-07	8/10/2000	1110	2	0.323	11.6	0.85	2.5	0.66	1978.0	22.6	0.0	0.0	0.5
VB-08	8/9/2000	1130	2	0.091	11.8	0.24	2.7	0.18	1967.5	33.1	0.5	0.5	0.5
VB-09	8/16/2000	1520	2	0.085	10.8	0.22	2.4	0.17	1967.0	33.6	0.5	0.5	0.8
VB-10	8/17/2000	1045	2	0.222	9.8	0.54	3.7	0.39	1974.0	26.6	0.0	0.3	0.5
VB-11	8/16/2000	945	2	0.190	10.7	0.48	2.1	0.39	1974.5	26.1	1.0	0.8	1.0
VB-12	8/15/2000	1115	2	0.143	10.5	0.36	3.2	0.26	1971.0	29.6	0.5	0.5	1.0
VB-13	8/8/2000	1225	2	3.529	10.5	8.86	3.1	6.92	C	C	nd	nd	nd
VB-14	8/7/2000	1745	4	3.675	9.8	8.96	3.1	7.09	C	C	nd	nd	nd
VB-14d	8/7/2000	1750	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
VR-01	7/6/1999	1230	1	1.221	7.8	2.85	6.6	1.69	1986.0	13.5	nd	0.3	0.8
VR-02	7/6/1999	1615	1	2.203	9.8	5.60	1.5	4.79	2000.0	-0.5	nd	nd	nd

Table 12. Summary of averaged sulfur hexafluoride data[1] in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; n, number of samples averaged; SF_6, sulfur hexafluoride; fmol/L, femtomoles per liter; ºC, degrees Celsius; pptv, parts per trillion by volume; cc/L, cubic centimeters per liter; Ex Air, excess air; C, contaminated, sample SF_6 concentration greater than that of water in equilibrium with modern air; HC, highly contaminated; <, actual recharge date is older than date shown; >, actual age is older than age shown; Meas. st. dev., standard deviation of measured values; Rtemp, recharge temperature; Apparent age uncertainties are based on standard deviation of measured ages, changes in recharge temperature (±1ºC) and excess air (±1 cc/L); Apparent recharge dates and ages are based on the North American air data of table 10; N/A, not applicable; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	n	SF_6 concentration in water (fmol/L)	Recharge Temperature (ºC)	SF_6 partial pressure (pptv)[1]	Excess air (cc/L)	Model SF_6 partial pressure remove Ex Air (pptv)[2]	Model SF_6 apparent recharge date (years)	Model SF_6 apparent age (years)	Model SF_6 apparent age uncertainity		
											Meas. st. dev. (years)	Rtemp ±1ºC (years)	Excess air ±1 cc/L (years)
VR-03	7/7/1999	1035	1	6.054	9.5	15.29	4.2	12.69	C	C	nd	nd	nd
VR-03d	7/7/1999	1040	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
VR-04	7/7/1999	1400	1	3.356	8.7	8.20	4.4	5.58	C	C	nd	nd	nd
VR-05	7/8/1999	1015	1	2.873	14.1	8.54	1.5	7.41	C	C	nd	nd	nd
VR-06	7/8/1999	1620	1	3.414	8.4	8.15	6.8	nd	C	C	nd	nd	nd
VR-07	7/8/1999	1820	1	2.726	7.2	6.16	4.8	4.15	1997.5	2.0	nd	0.5	1.0
VR-08	7/9/1999	1015	1	1.967	9.4	4.89	2.0	4.02	1997.0	2.5	nd	nd	1.5
VR-09	7/9/1999	1300	2	2.342	9.6	5.85	2.9	4.41	1998.5	1.0	0.5	nd	1.5
VR-10	7/9/1999	1500	1	2.097	9.5	5.25	1.4	nd	C	C	nd	nd	nd
VR-11	7/9/1999	1645	2	0.861	9.1	2.12	4.2	1.45	1984.5	15.0	0.3	0.3	0.8
VR-12	7/21/1999	945	2	2.960	10.8	7.96	3.4	5.69	C	C	nd	nd	nd
VR-13	7/21/1999	1250	2	1.309	13.1	3.89	2.4	2.95	1992.5	7.1	0.3	0.5	1.3
VR-14	7/22/1999	1200	2	2.411	9.5	6.34	3.7	4.42	1998.5	1.1	0.0	0.5	1.0
VR-15	8/10/1999	1400	2	0.062	4.2	0.12	3.8	0.09	1963.0	36.6	0.5	0.5	0.5
VR-15bt	8/10/1999	1405	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
VR-16	8/11/1999	1330	1	0.396	5.2	0.83	5.2	0.56	1977.0	22.6	nd	0.3	0.5
VR-17	8/11/1999	1630	1	5.732	11.4	15.37	2.3	13.87	C	C	nd	nd	nd
VR-18	8/12/1999	1130	2	0.345	9.8	0.93	8.2	0.06	1958.5	41.1	0.5	nd	nd
VR-19	8/24/1999	1050	3	0.801	6.1	1.71	8.3	0.92	1980.5	19.1	0.0	0.0	1.0
VR-20	8/24/1999	1315	4	1.460	10.4	3.88	0.9	3.50	1995.0	4.6	0.0	0.5	1.5
VR-21	8/25/1999	1530	4	453.840	11.0	1,206.08	4.1	1,157.47	HC	HC	nd	nd	nd
VR-22	8/26/1999	925	4	1.155	11.1	3.11	2.3	2.44	1990.5	9.2	0.3	0.3	1.3
VR-23	8/26/1999	1400	2	52.465	14.5	159.06	2.9	119.52	HC	HC	nd	nd	nd
VR-24	10/27/1999	925	2	0.122	6.2	0.26	6.6	0.16	1966.5	33.3	1.8	1.5	1.5
VR-25	10/27/1999	1340	2	0.497	5.7	1.04	2.4	0.85	1980.0	19.8	0.0	0.3	0.5
VR-26	10/28/1999	1010	2	0.817	7.1	1.93	3.2	1.45	1984.5	15.3	0.0	0.3	0.8

Table 12. Summary of averaged sulfur hexafluoride data[1] in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; n, number of samples averaged; SF_6, sulfur hexafluoride; fmol/L, femtomoles per liter; ºC, degrees Celsius; pptv, parts per trillion by volume; cc/L, cubic centimeters per liter; Ex Air, excess air; C, contaminated, sample SF_6 concentration greater than that of water in equilibrium with modern air; HC, highly contaminated; <, actual recharge date is older than date shown; >, actual age is older than age shown; Meas. st. dev., standard deviation of measured values; Rtemp, recharge temperature; Apparent age uncertainties are based on standard deviation of measured ages, changes in recharge temperature (±1ºC) and excess air (±1 cc/L); Apparent recharge dates and ages are based on the North American air data of table 10; N/A, not applicable; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	n	SF_6 concentration in water (fmol/L)	Recharge Temperature (ºC)	SF_6 partial pressure (pptv)[1]	Excess air (cc/L)	Model SF_6 partial pressure remove Ex Air (pptv)[2]	Model SF_6 apparent recharge date (years)	Model SF_6 apparent age (years)	Model SF_6 apparent age uncertainity		
											Meas. st. dev. (years)	Rtemp ±1ºC (years)	Excess air ±1 cc/L (years)
VR-27	10/28/1999	1345	2	1.456	8.3	3.53	3.1	2.64	1991.0	8.8	0.3	0.3	0.8
VR-28	7/12/2000	1415	1	0.333	8.3	0.87	3.7	0.61	1977.5	23.0	nd	0.3	0.5
VR-29	7/13/2000	1108	2	0.138	7.8	0.33	6.2	0.21	1968.5	32.0	0.3	0.3	0.8
VR-30	7/13/2000	1415	2	0.295	13.2	0.87	3.0	0.62	1977.5	23.0	0.5	0.5	0.8
VR-31	7/17/2000	950	2	0.124	6.2	0.28	4.5	0.19	1968.0	32.5	0.0	0.3	0.5
VR-32	7/17/2000	1321	2	0.261	9.7	0.68	4.6	0.44	1975.0	25.5	0.3	0.3	0.5
VR-33	7/18/2000	1030	2	2.128	8.7	5.25	4.1	nd	C	C	nd	nd	nd
VR-34	7/18/2000	1400	2	1.157	10.2	3.01	0.1	2.98	1993.0	7.5	0.3	0.5	1.3
VR-35	7/19/2000	915	2	0.050	11.4	0.14	4.2	0.11	1964.5	36.1	0.8	0.5	0.8
VR-35b	7/19/2000	1000	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
VR-36	7/20/2000	1430	2	1.194	12.4	3.50	1.5	2.93	1992.5	8.1	0.0	0.5	1.5
VR-37	7/17/2000	950	2	1.194	11.2	3.32	2.6	2.52	1990.5	10.0	0.0	0.3	1.0
VR-37d	7/17/2000	955	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
VR-38	7/18/2000	915	2	2.217	10.6	6.06	7.3	nd	C	C	nd	nd	nd
VR-39	7/18/2000	1330	2	0.311	10.2	0.83	3.8	0.57	1977.0	23.5	0.0	0.0	0.5
VR-40	7/19/2000	925	2	0.239	9.5	0.62	4.6	0.40	1974.5	26.1	1.0	0.5	1.0
VR-41	7/19/2000	1125	2	0.344	9.5	0.89	5.2	0.56	1977.0	23.6	0.3	0.3	0.5
VR-42	7/20/2000	1200	2	4.258	8.6	11.41	2.0	10.08	C	C	nd	nd	nd
VR-42bt	7/20/2000	1205	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
VR-43	7/20/2000	1740	3	0.879	7.6	2.25	5.4	1.38	1984.0	16.6	1.8	1.5	1.8
VR-44	7/20/2000	900	3	3.587	10.9	10.58	3.6	7.94	C	C	nd	nd	nd
VR-45	7/25/2000	920	2	3.523	8.6	8.59	4.6	5.86	C	C	nd	nd	nd
VR-46	7/25/2000	1310	2	1.741	8.8	4.32	7.2	2.31	1989.5	11.1	0.0	0.0	2.0
VR-47	7/26/2000	1015	2	6.575	10.2	17.10	3.4	14.96	C	C	nd	nd	nd
VTDW-01	9/16/1999	1505	3	1.479	11.6	4.30	1.9	3.47	1995.0	4.7	1.3	1.0	1.8
VTDW-03A	7/15/2000	1300	1	0.281	12.5	0.85	1.7	0.69	1978.5	22.0	nd	0.3	0.8

Table 12. Summary of averaged sulfur hexafluoride data[1] in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; n, number of samples averaged; SF_6, sulfur hexafluoride; fmol/L, femtomoles per liter; ºC, degrees Celsius; pptv, parts per trillion by volume; cc/L, cubic centimeters per liter; Ex Air, excess air; C, contaminated, sample SF_6 concentration greater than that of water in equilibrium with modern air; HC, highly contaminated; <, actual recharge date is older than date shown; >, actual age is older than age shown; Meas. st. dev., standard deviation of measured values; Rtemp, recharge temperature; Apparent age uncertainties are based on standard deviation of measured ages, changes in recharge temperature (±1ºC) and excess air (±1 cc/L); Apparent recharge dates and ages are based on the North American air data of table 10; N/A, not applicable; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	n	SF_6 concentration in water (fmol/L)	Recharge Temperature (ºC)	SF_6 partial pressure (pptv)[1]	Excess air (cc/L)	Model SF_6 partial pressure remove Ex Air (pptv)[2]	Model SF_6 apparent recharge date (years)	Model SF_6 apparent age (years)	Model SF_6 apparent age uncertainity		
											Meas. st. dev. (years)	Rtemp ±1ºC (years)	Excess air ±1 cc/L (years)
VTDW-03B	7/15/2000	1700	1	0.448	13.7	1.41	1.5	1.17	1982.5	18.0	nd	0.3	1.0
VTDW-07A	7/14/2000	1430	1	0.369	12.6	1.12	1.7	0.91	1980.5	20.0	nd	0.3	1.0
VTDW-07B	7/14/2000	1610	1	8.568	13.7	26.97	0.0	26.97	C	C	nd	nd	nd
VTDW-08	9/16/1999	1800	2	1.407	16.2	4.86	2.5	3.51	1995.0	4.7	nd	nd	1.5

[1] Water samples for the determination of SF6 in the U.S. Geological Survey Chlorofluorocarbon, Reston, Va., were analyzed using purge and trap gas chromatographic procedures (Busenberg and Plummer, 2000). Apparent SF6 recharge dates and ages were calculated using the SF6 program version 3, revised July 23, 2001 (Microsoft Excel) by E. Busenberg of the U.S. Geological Survey.

Table 13. Summary of tritium, dissolved helium, and dissolved neon data in water samples from wells and springs in Virginia, 1998-2000

[VAS, Virginia Aquifer Susceptibility study; ^3H, tritium; TU, tritium unit, 1 TU=1 atom of ^3H in 10^{18} atoms of H; 2σ, 2 standard deviations; USGS, U.S. Geological Survey Low-Level ^3H Laboratory in Menlo Park, Calif.; LDEO, Noble Gas Laboratory at Lamont-Doherty Earth Observatory of Columbia University, Palisades, N.Y.; ccSTP/g, cubic centimeters at standard temperature and pressure per gram; He, helium, Ne, neon, Δ^4He (%), percentage of ^4He greater than solubility equilibrium concentration; $^3He=((R_{sample}/R_{air})-1)x100$; R is the ratio $^3He/^4He$; $R_{air}=1.384x10^{-6}$; ΔNe (%), percentage of Ne greater than solubility equilibrium concentration; Terr., terrigenic; <, actual value is known to be less than value shown; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	^3H (TU)	^3H error 2σ (±TU)	^3H Lab1	^4He $x10^{-8}$ $(ccSTP/g)^2$	Δ^4He (%)	δ^3He (%)2	Ne $x10^{-8}$ $(ccSTP/g)^2$	ΔNe (%)	Terr. He (%)
AP-01	7/10/2000	1045	7.2	0.6	USGS	nd	nd	nd	nd	nd	nd
AP-02	7/10/2000	1400	7.5	0.2	LDEO	15.425	250.2	-57.17	25.089	31.2	59.4
AP-03	7/20/2000	1045	8.5	0.6	USGS	nd	nd	nd	nd	nd	nd
AP-03d	7/20/2000	1050	8.5	0.6	USGS	nd	nd	nd	nd	nd	nd
AP-04	7/11/2000	1050	6.2	0.5	USGS	nd	nd	nd	nd	nd	nd
AP-05	7/12/2000	950	6.3	0.5	USGS	nd	nd	nd	nd	nd	nd
AP-06	7/13/2000	905	7.7	0.5	USGS	nd	nd	nd	nd	nd	nd
AP-07	7/13/2000	1445	7.4	0.3	LDEO	8.967	115.9	-8.94	18.784	5.3	50.6
AP-08	7/10/2000	950	6.5	0.4	USGS	nd	nd	nd	nd	nd	nd
AP-09	7/10/2000	1345	7.6	0.5	USGS	nd	nd	nd	nd	nd	nd
AP-10	7/11/2000	1115	8.3	0.6	USGS	nd	nd	nd	nd	nd	nd
AP-11	7/11/2000	1530	8.9	0.6	USGS	nd	nd	nd	nd	nd	nd
AP-12	7/12/2000	1140	5.9	0.4	USGS	nd	nd	nd	nd	nd	nd
AP-13	7/12/2000	1430	6.5	0.4	USGS	nd	nd	nd	nd	nd	nd
BR-01	7/19/1999	1100	9.0	0.6	USGS	nd	nd	nd	nd	nd	nd
BR-02	7/19/1999	1500	9.5	0.2	LDEO	0.000	-100.0	nd	76.490	299.8	nd
BR-03	7/20/1999	910	8.1	0.2	LDEO	4.622	12.5	1.14	19.606	9.4	-0.7
BR-04	7/20/1999	1425	12.6	0.8	USGS	nd	nd	nd	nd	nd	nd
BR-05	8/25/1999	1115	2.5	0.8	LDEO	8.306	85.6	1.90	30.330	56.0	6.7
BR-06	9/13/1999	1715	12.1	0.3	LDEO	5.383	19.1	2.60	20.804	6.4	7.6
BR-07	9/14/1999	940	9.8	0.6	USGS	nd	nd	nd	nd	nd	nd
BR-08	9/16/1999	940	10.6	0.3	LDEO	4.384	4.5	4.00	18.167	1.2	2.3
BR-09	10/18/1999	1720	12.4	0.8	USGS	nd	nd	nd	nd	nd	nd
BR-10	10/26/1999	947	10.9	0.6	USGS	nd	nd	nd	nd	nd	nd
CP-01	6/23/1998	1338	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-01d	6/23/1998	1342	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-02	6/24/1998	1142	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-03	6/25/1998	1231	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-04	7/1/1998	1024	0.5	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-05	7/6/1998	1213	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-06	7/6/1998	1434	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-07	7/7/1998	1158	0.4	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-08	7/7/1998	1459	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-09	7/8/1998	1159	0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-10	7/8/1998	1505	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-11	7/9/1998	1121	0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-11b	7/9/1998	1126	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-12	7/14/1998	1327	0.0	0.1	LDEO	6.217	35.6	-3.35	24.494	24.8	1.5
CP-13	7/15/1998	920	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd

Table 13. Summary of tritium, dissolved helium, and dissolved neon data in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; ^3H, tritium; TU, tritium unit, 1 TU=1 atom of ^3H in 10^{18} atoms of H; 2σ, 2 standard deviations; USGS, U.S. Geological Survey Low-Level ^3H Laboratory in Menlo Park, Calif.; LDEO, Noble Gas Laboratory at Lamont-Doherty Earth Observatory of Columbia University, Palisades, N.Y.; ccSTP/g, cubic centimeters at standard temperature and pressure per gram; He, helium, Ne, neon, Δ^4He (%), percentage of ^4He greater than solubility equilibrium concentration; $^3He=((R_{sample}/R_{air})-1)x100$; R is the ratio $^3He/^4He$; $R_{air}=1.384x10^{-6}$; ΔNe (%), percentage of Ne greater than solubility equilibrium concentration; Terr., terrigenic; <, actual value is known to be less than value shown; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	^3H (TU)	^3H error 2σ (±TU)	^3H Lab1	^4He x10^{-8} (ccSTP/g)2	Δ^4He (%)	δ^3He (%)2	Ne x10^{-8} (ccSTP/g)2	ΔNe (%)	Terr. He (%)
CP-14	7/15/1998	1220	9.5	0.4	LDEO	5.496	21.6	60.66	22.951	20.8	-2.3
CP-15	7/15/1998	1410	0.5	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-16	7/16/1998	1008	0.0	0.1	LDEO	8.046	73.9	-23.65	25.294	26.1	21.4
CP-17	7/16/1998	1351	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-18	7/27/1998	1117	0.0	0.1	LDEO	6.453	40.3	-7.76	24.645	23.5	4.5
CP-19	7/27/1998	1545	0.1	0.1	LDEO	7.740	69.3	-23.20	24.688	25.4	19.8
CP-20	7/28/1998	1102	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-21	7/29/1998	1059	2.9	0.2	LDEO	9.154	101.3	4.62	26.007	35.0	28.6
CP-22	7/30/1998	1048	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-23	8/3/1998	1126	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-23d	8/3/1998	1131	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-24	8/4/1998	936	0.6	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-25	8/4/1998	1440	0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-26	8/5/1998	1325	8.1	0.3	LDEO	5.916	29.6	22.40	23.888	22.6	-0.1
CP-27	8/6/1998	1001	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-28	8/17/1998	1015	7.5	0.6	USGS	nd	nd	nd	nd	nd	nd
CP-29	8/17/1998	1340	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-30	8/18/1998	1000	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-31	8/19/1998	1620	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-32	8/31/1998	1053	0.7	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-33	8/31/1998	1453	0.5	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-34	8/31/1998	1731	5.7	0.5	USGS	nd	nd	nd	nd	nd	nd
CP-34d	8/31/1998	1736	4.7	0.5	USGS	nd	nd	nd	nd	nd	nd
CP-35	9/1/1998	1038	0.4	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-36	9/1/1998	1545	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-37	9/2/1998	950	0.5	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-38	9/2/1998	1259	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-39	9/2/1998	1548	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-40	9/3/1998	919	0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-41	9/10/1998	1115	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-42	9/10/1998	1440	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-43	10/1/1998	1135	0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-44	10/5/1998	1110	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-45	10/5/1998	1505	13.0	0.5	LDEO	11.744	156.6	38.64	46.969	140.1	-6.9
CP-46	10/6/1998	1020	11.4	0.5	LDEO	7.850	72.2	44.08	25.511	31.0	18.1
CP-47	10/6/1998	1430	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-48	10/7/1998	1027	15.4	1.0	USGS	nd	nd	nd	nd	nd	nd
CP-49	10/27/1998	1025	0.0	0.1	LDEO	8.071	75.4	-29.64	23.115	16.5	29.1
CP-50	10/28/1998	1205	8.6	0.3	LDEO	4.769	4.8	2.19	19.661	1.2	1.4

Table 13. Summary of tritium, dissolved helium, and dissolved neon data in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; ^3H, tritium; TU, tritium unit, 1 TU=1 atom of ^3H in 10^{18} atoms of H; 2σ, 2 standard deviations; USGS, U.S. Geological Survey Low-Level ^3H Laboratory in Menlo Park, Calif.; LDEO, Noble Gas Laboratory at Lamont-Doherty Earth Observatory of Columbia University, Palisades, N.Y.; ccSTP/g, cubic centimeters at standard temperature and pressure per gram; He, helium, Ne, neon, Δ^4He (%), percentage of ^4He greater than solubility equilibrium concentration; $^3He=((R_{sample}/R_{air})-1)x100$; R is the ratio $^3He/^4He$; $R_{air}=1.384x10^{-6}$; ΔNe (%), percentage of Ne greater than solubility equilibrium concentration; Terr., terrigenic; <, actual value is known to be less than value shown; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	^3H (TU)	^3H error 2σ (±TU)	^3H Lab1	^4He $x10^{-8}$ (ccSTP/g)2	Δ^4He (%)	δ^3He (%)2	Ne $x10^{-8}$ (ccSTP/g)2	ΔNe (%)	Terr. He (%)
CP-51	11/4/1998	1220	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
CP-51d	11/4/1998	1225	0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
PD-01	6/28/1999	1435	0.3	0.1	LDEO	47.252	930.7	-83.80	26.849	34.9	85.5
PD-02	6/29/1999	1530	9.3	0.4	LDEO	89.670	1910.0	-76.83	23.401	22.6	93.6
PD-03	6/30/1999	1030	5.1	0.2	LDEO	5.564	24.6	51.37	23.552	24.3	-4.9
PD-04	6/30/1999	1500	6.5	nd	LDEO	7.527	69.2	12.67	23.639	24.1	22.1
PD-05	7/1/1999	1240	11.1	0.4	LDEO	9.144	103.9	0.98	26.478	38.9	27.5
PD-06	8/23/1999	1245	11.2	0.3	LDEO	9.728	108.8	5.09	35.444	72.1	5.3
PD-07	8/23/1999	1515	10.7	0.3	LDEO	8.767	93.3	10.99	30.668	57.3	10.4
PD-08	8/30/1999	1100	7.1	0.5	USGS	nd	nd	nd	nd	nd	nd
PD-09	8/31/1999	1045	1.4	0.3	USGS	nd	nd	nd	nd	nd	nd
PD-10	9/1/1999	1045	12.1	0.3	LDEO	5.381	20.5	33.54	21.952	16.0	0.9
PD-11	9/1/1999	1350	12.8	0.3	LDEO	6.356	42.1	48.37	24.679	29.9	3.3
PD-12	9/1/1999	1720	7.0	0.5	USGS	nd	nd	nd	nd	nd	nd
PD-13	9/2/1999	1030	11.5	0.3	LDEO	5.823	27.7	55.88	23.517	19.5	1.3
PD-14	9/2/1999	1230	10.1	0.2	LDEO	6.360	39.9	34.41	24.943	27.1	2.7
PD-15	9/2/1999	1545	12.6	0.3	LDEO	9.621	113.4	23.36	22.760	18.7	42.0
PD-15d	9/2/1999	1550	12.4	0.3	LDEO	9.626	113.4	23.34	22.562	17.6	42.6
PD-16	9/13/1999	1035	2.4	0.3	USGS	nd	nd	nd	nd	nd	nd
PD-17	9/13/1999	1448	0.6	0.3	USGS	nd	nd	nd	nd	nd	nd
PD-18	10/18/1999	1030	5.4	0.4	USGS	nd	nd	nd	nd	nd	nd
PD-19	10/19/1999	1130	11.3	0.3	LDEO	6.609	44.8	48.51	25.084	26.9	5.7
PD-20	10/19/1999	1545	6.5	0.2	LDEO	8.622	88.9	4.79	29.057	47.2	14.5
PD-20b	10/20/1999	800	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-21	10/25/1999	920	0.8	0.3	USGS	nd	nd	nd	nd	nd	nd
PD-22	10/25/1999	1240	8.2	0.6	USGS	nd	nd	nd	nd	nd	nd
PD-23	10/25/1999	1722	3.4	0.3	USGS	nd	nd	nd	nd	nd	nd
PD-24	10/26/1999	1324	12.3	0.3	LDEO	0.209	-95.4	0.00	0.818	-95.9	486.5
PD-25	6/27/2000	1035	8.9	0.3	LDEO	6.310	42.6	74.19	23.237	22.2	9.3
PD-26	6/27/2000	1500	6.5	0.5	USGS	nd	nd	nd	nd	nd	nd
PD-27	6/28/2000	920	2.5	0.3	USGS	nd	nd	nd	nd	nd	nd
PD-28	6/28/2000	1440	12.5	0.3	LDEO	0.336	-92.6	0.00	0.785	-96.0	314.0
PD-29	6/29/2000	1130	8.0	0.3	LDEO	8.009	79.3	11.95	22.853	22.0	29.8
PD-30	6/29/2000	1540	1.3	0.1	LDEO	7.856	70.2	-2.92	29.130	44.8	5.4
VB-01	5/13/1999	1615	0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
VB-02	5/14/1999	1115	0.9	0.3	USGS	nd	nd	nd	nd	nd	nd
VB-03	5/10/1999	1830	2.5	0.3	USGS	nd	nd	nd	nd	nd	nd
VB-04	5/12/1999	1230	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
VB-05	8/14/2000	1415	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd

Table 13. Summary of tritium, dissolved helium, and dissolved neon data in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; ^3H, tritium; TU, tritium unit, 1 TU=1 atom of ^3H in 10^{18} atoms of H; 2σ, 2 standard deviations; USGS, U.S. Geological Survey Low-Level ^3H Laboratory in Menlo Park, Calif.; LDEO, Noble Gas Laboratory at Lamont-Doherty Earth Observatory of Columbia University, Palisades, N.Y.; ccSTP/g, cubic centimeters at standard temperature and pressure per gram; He, helium, Ne, neon, Δ^4He (%), percentage of ^4He greater than solubility equilibrium concentration; $^3He=((R_{sample}/R_{air})-1)x100$; R is the ratio $^3He/^4He$; $R_{air}=1.384x10^{-6}$; ΔNe (%), percentage of Ne greater than solubility equilibrium concentration; Terr., terrigenic; <, actual value is known to be less than value shown; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	^3H (TU)	^3H error 2σ (±TU)	^3H Lab1	^4He x10^{-8} (ccSTP/g)2	Δ^4He (%)	δ^3He (%)2	Ne x10^{-8} (ccSTP/g)2	ΔNe (%)	Terr. He (%)
VB-05b	8/14/2000	1410	nd	nd	nd	nd	nd	nd	nd	nd	nd
VB-06	8/11/2000	1000	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
VB-07	8/10/2000	1110	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
VB-08	8/9/2000	1130	0.4	0.3	USGS	nd	nd	nd	nd	nd	nd
VB-09	8/16/2000	1520	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
VB-10	8/17/2000	1045	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
VB-11	8/16/2000	945	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
VB-12	8/15/2000	1115	0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
VB-13	8/8/2000	1225	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
VB-14	8/7/2000	1745	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
VB-14d	8/7/2000	1750	<0.3	0.3	USGS	nd	nd	nd	nd	nd	nd
VR-01	7/6/1999	1230	0.0	0.1	LDEO	8.547	90.1	-3.34	34.267	73.5	-4.4
VR-02	7/6/1999	1615	4.5	0.2	LDEO	5.253	17.9	8.49	22.317	15.1	-3.2
VR-03	7/7/1999	1035	4.7	0.2	LDEO	7.484	68.8	6.13	26.145	35.4	12.8
VR-03d	7/7/1999	1040	5.1	0.2	LDEO	7.297	64.5	5.99	26.175	35.5	10.5
VR-04	7/7/1999	1400	3.8	0.2	LDEO	34.108	665.7	-5.32	130.145	568.3	-7.0
VR-05	7/8/1999	1015	7.0	0.2	LDEO	5.076	14.1	8.91	20.442	8.0	3.2
VR-06	7/8/1999	1620	4.7	0.2	LDEO	7.983	77.4	8.45	32.833	66.6	-5.3
VR-07	7/8/1999	1820	3.7	0.1	LDEO	7.453	64.6	14.02	29.891	49.7	-1.5
VR-08	7/9/1999	1015	0.8	0.1	LDEO	16.991	278.8	-58.80	22.692	16.1	67.1
VR-09	7/9/1999	1300	5.2	0.2	LDEO	15.967	255.3	-43.89	24.764	26.6	61.5
VR-10	7/9/1999	1500	3.7	0.2	LDEO	10.659	138.0	-39.92	22.639	16.1	48.2
VR-11	7/9/1999	1645	0.6	0.1	LDEO	7.051	57.5	-1.97	28.290	44.8	-1.1
VR-12	7/21/1999	945	7.2	0.5	USGS	nd	nd	nd	nd	nd	nd
VR-13	7/21/1999	1250	12.3	0.3	LDEO	5.551	29.5	18.56	22.410	22.3	1.3
VR-14	7/22/1999	1200	3.1	0.2	LDEO	6.726	58.0	13.22	24.838	34.0	8.2
VR-15	8/10/1999	1400	0.8	0.3	USGS	nd	nd	nd	nd	nd	nd
VR-15bt	8/10/1999	1405	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-16	8/11/1999	1330	6.3	0.5	USGS	nd	nd	nd	nd	nd	nd
VR-17	8/11/1999	1630	8.2	0.2	LDEO	6.035	34.6	13.71	22.899	18.4	7.8
VR-18	8/12/1999	1130	8.6	0.6	USGS	nd	nd	nd	nd	nd	nd
VR-19	8/24/1999	1050	11.1	0.3	LDEO	9.133	99.3	70.30	36.655	80.4	-4.4
VR-20	8/24/1999	1315	8.2	0.9	LDEO	4.915	12.9	5.17	20.434	8.3	0.4
VR-21	8/25/1999	1530	6.1	0.2	LDEO	6.556	47.1	15.02	25.023	30.0	5.6
VR-22	8/26/1999	925	10.2	0.2	LDEO	7.949	79.9	-0.75	22.828	19.6	29.6
VR-23	8/26/1999	1400	3.7	0.4	USGS	nd	nd	nd	nd	nd	nd
VR-24	10/27/1999	925	2.2	0.3	USGS	nd	nd	nd	nd	nd	nd
VR-25	10/27/1999	1340	1.1	0.3	USGS	nd	nd	nd	nd	nd	nd
VR-26	10/28/1999	1010	5.6	0.2	LDEO	6.281	45.2	19.66	24.638	29.2	3.6

Table 13. Summary of tritium, dissolved helium, and dissolved neon data in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; ^3H, tritium; TU, tritium unit, 1 TU=1 atom of ^3H in 10^{18} atoms of H; 2σ, 2 standard deviations; USGS, U.S. Geological Survey Low-Level ^3H Laboratory in Menlo Park, Calif.; LDEO, Noble Gas Laboratory at Lamont-Doherty Earth Observatory of Columbia University, Palisades, N.Y.; ccSTP/g, cubic centimeters at standard temperature and pressure per gram; He, helium, Ne, neon, Δ^4He (%), percentage of ^4He greater than solubility equilibrium concentration; $^3He=((R_{sample}/R_{air})-1)x100$; R is the ratio $^3He/^4He$; $R_{air}=1.384x10^{-6}$; ΔNe (%), percentage of Ne greater than solubility equilibrium concentration; Terr., terrigenic; <, actual value is known to be less than value shown; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	^3H (TU)	^3H error 2σ (±TU)	^3H Lab1	^4He x10^{-8} (ccSTP/g)2	Δ^4He (%)	δ^3He (%)2	Ne x10^{-8} (ccSTP/g)2	ΔNe (%)	Terr. He (%)
VR-27	10/28/1999	1345	6.9	0.5	USGS	nd	nd	nd	nd	nd	nd
VR-28	7/12/2000	1415	7.3	0.2	LDEO	5.976	45.3	2.33	23.712	31.6	1.7
VR-29	7/13/2000	1108	5.9	0.5	USGS	nd	nd	nd	nd	nd	nd
VR-30	7/13/2000	1415	0.9	0.3	USGS	nd	nd	nd	nd	nd	nd
VR-31	7/17/2000	950	4.4	0.4	USGS	nd	nd	nd	nd	nd	nd
VR-32	7/17/2000	1321	1.8	0.1	LDEO	11.804	173.9	-40.17	25.174	34.2	46.9
VR-33	7/18/2000	1030	9.0	0.2	LDEO	6.156	39.7	4.40	25.769	33.8	-3.5
VR-34	7/18/2000	1400	4.8	0.4	USGS	nd	nd	nd	nd	nd	nd
VR-35	7/19/2000	915	6.1	0.2	LDEO	8.807	108.7	-27.66	21.526	18.3	40.4
VR-35b	7/19/2000	1000	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-36	7/20/2000	1430	9.2	0.2	LDEO	5.011	17.8	-1.08	19.753	8.3	5.9
VR-37	7/17/2000	950	5.8	0.2	LDEO	8.912	107.7	-4.16	23.199	25.3	35.6
VR-37d	7/17/2000	955	6.3	0.2	LDEO	9.198	114.3	-3.85	22.644	22.1	39.3
VR-38	7/18/2000	915	10.5	0.3	LDEO	8.107	89.7	20.31	30.363	64.1	4.1
VR-39	7/18/2000	1330	4.0	0.1	LDEO	6.296	46.1	18.93	24.507	31.1	3.6
VR-40	7/19/2000	925	2.7	0.1	LDEO	6.232	44.1	13.14	24.850	32.0	0.8
VR-41	7/19/2000	1125	1.0	0.3	USGS	nd	nd	nd	nd	nd	nd
VR-42	7/20/2000	1200	8.1	0.2	LDEO	4.841	19.6	-3.41	21.076	19.1	-4.1
VR-42bt	7/20/2000	1205	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-43	7/20/2000	1740	7.5	0.2	LDEO	7.347	80.1	26.09	27.596	53.9	5.7
VR-44	7/20/2000	900	11.5	0.3	LDEO	5.929	47.9	42.92	23.997	38.6	0.4
VR-45	7/25/2000	920	3.7	0.2	LDEO	0.033	-99.2	7867.05	0.000	-100.0	3185.2
VR-46	7/25/2000	1310	4.3	0.4	USGS	nd	nd	nd	nd	nd	nd
VR-47	7/26/2000	1015	4.7	0.1	LDEO	6.636	50.3	0.72	24.466	27.7	9.2
VTDW-01	9/16/1999	1505	8.4	0.2	LDEO	4.720	13.4	3.08	18.970	5.8	3.4
VTDW-03A	7/15/2000	1300	4.4	0.2	LDEO	7.374	77.4	-18.32	19.529	9.6	36.1
VTDW-03B	7/15/2000	1700	5.1	0.2	LDEO	7.523	81.8	-15.73	19.352	9.7	38.6
VTDW-07A	7/14/2000	1430	4.8	0.2	LDEO	6.007	44.6	25.23	19.643	10.4	21.5
VTDW-07B	7/14/2000	1610	nd	nd	nd	nd	nd	nd	nd	nd	nd
VTDW-08	9/16/1999	1800	8.9	0.2	LDEO	4.819	17.6	3.99	19.917	15.4	1.6

1 Water samples for the determination of ^3H in the U.S. Geological Survey Low-Level 3H Laboratory, Menlo Park, Calif., were enriched electrolytically and analyzed by liquid scintillation counting following procedures modified from Thatcher and others (1977). Water samples for the determination of ^3H in the Noble Gas Laboratory at Lamont-Doherty Earth Observatory of Columbia University, Palisades, N.Y., were analyzed by the helium-3 ingrowth method (Clarke and others, 1976; Bayer and others, 1989).
2 Water samples for the determination of δ^3He, ^4He, and Ne in the Noble Gas Laboratory at Lamont-Doherty Earth Observatory of Columbia University, Palisades, N.Y., were analyzed by mass-spectrometric procedures outlined in Ekwurzel and others (1994) and Ludin and others (1998).

Table 14. Summary of apparent tritium/helium-3 ages in water samples from wells and springs in Virginia, 1998-2000

[VAS, Virginia Aquifer Susceptibility study; Uncorr., apparent age not corrected for terrigenic helium; Uncorr. Err., one standard deviation age error of uncorrected apparent age; Corr., apparent age corrected for terrigenic helium; Corr. Err., one standard deviation age error of apparent age corrected for terrigenic helium; Terr. He, terrigenic helium; Y, yes, terrigenic helium correction needed; N, no, terrigenic helium correction not needed; nd, not determined. All apparent age calculations based on recharge temperatures determined for the respective samples. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Tritium/Helium-3 ($^3H/^3He$) apparent age						
			Uncorr. (years)	Uncorr. Err. (years)	Corr (years)	Corr Err (years)	Terr. He (Y/N)	Final (years)	Final Error (years)
AP-01	7/10/2000	1045	nd	nd	nd	nd	nd	nd	nd
AP-02	7/10/2000	1400	nd	nd	4.9	0.8	Y	4.9	0.8
AP-03	7/20/2000	1045	nd	nd	nd	nd	nd	nd	nd
AP-03d	7/20/2000	1050	nd	nd	nd	nd	nd	nd	nd
AP-04	7/11/2000	1050	nd	nd	nd	nd	nd	nd	nd
AP-05	7/12/2000	950	nd	nd	nd	nd	nd	nd	nd
AP-06	7/13/2000	905	nd	nd	nd	nd	nd	nd	nd
AP-07	7/13/2000	1445	-14.4	1.1	24.1	0.3	Y	24.1	0.3
AP-08	7/10/2000	950	nd	nd	nd	nd	nd	nd	nd
AP-09	7/10/2000	1345	nd	nd	nd	nd	nd	nd	nd
AP-10	7/11/2000	1115	nd	nd	nd	nd	nd	nd	nd
AP-11	7/11/2000	1530	nd	nd	nd	nd	nd	nd	nd
AP-12	7/12/2000	1140	nd	nd	nd	nd	nd	nd	nd
AP-13	7/12/2000	1430	nd	nd	nd	nd	nd	nd	nd
BR-01	7/19/1999	1100	nd	nd	nd	nd	nd	nd	nd
BR-02	7/19/1999	1500	nd	nd	nd	nd	nd	nd	nd
BR-03	7/20/1999	910	1.5	0.2	1.8	0.4	N	1.5	0.2
BR-04	7/20/1999	1425	nd	nd	nd	nd	nd	nd	nd
BR-05	8/25/1999	1115	7.6	1.3	20.2	2.1	Y	20.2	2.1
BR-06	9/13/1999	1715	1.7	0.1	5.1	0.2	Y	5.1	0.2
BR-07	9/14/1999	940	nd	nd	nd	nd	nd	nd	nd
BR-08	9/16/1999	940	2.2	0.1	3.2	0.3	N	2.2	0.1
BR-09	10/18/1999	1720	nd	nd	nd	nd	nd	nd	nd
BR-10	10/26/1999	947	nd	nd	nd	nd	nd	nd	nd
CP-01	6/23/1998	1338	nd	nd	nd	nd	nd	nd	nd
CP-01d	6/23/1998	1342	nd	nd	nd	nd	nd	nd	nd
CP-02	6/24/1998	1142	nd	nd	nd	nd	nd	nd	nd
CP-03	6/25/1998	1231	nd	nd	nd	nd	nd	nd	nd
CP-04	7/1/1998	1024	nd	nd	nd	nd	nd	nd	nd
CP-05	7/6/1998	1213	nd	nd	nd	nd	nd	nd	nd
CP-06	7/6/1998	1434	nd	nd	nd	nd	nd	nd	nd
CP-07	7/7/1998	1158	nd	nd	nd	nd	nd	nd	nd
CP-08	7/7/1998	1459	nd	nd	nd	nd	nd	nd	nd
CP-09	7/8/1998	1159	nd	nd	nd	nd	nd	nd	nd
CP-10	7/8/1998	1505	nd	nd	nd	nd	nd	nd	nd
CP-11	7/9/1998	1121	nd	nd	nd	nd	nd	nd	nd
CP-11b	7/9/1998	1126	nd	nd	nd	nd	nd	nd	nd
CP-12	7/14/1998	1327	35.0	20.6	nd	nd	Y	nd	nd
CP-13	7/15/1998	920	nd	nd	nd	nd	nd	nd	nd
CP-14	7/15/1998	1220	20.6	0.4	20.0	0.5	N	20.6	0.4
CP-15	7/15/1998	1410	nd	nd	nd	nd	nd	nd	nd

Table 14. Summary of apparent tritium/helium-3 ages in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Uncorr., apparent age not corrected for terrigenic helium; Uncorr. Err., one standard deviation age error of uncorrected apparent age; Corr., apparent age corrected for terrigenic helium; Corr. Err., one standard deviation age error of apparent age corrected for terrigenic helium; Terr. He, terrigenic helium; Y, yes, terrigenic helium correction needed; N, no, terrigenic helium correction not needed; nd, not determined. All apparent age calculations based on recharge temperatures determined for the respective samples. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Tritium/Helium-3 ($^3H/^3He$) apparent age						
			Uncorr. (years)	Uncorr. Err. (years)	Corr (years)	Corr Err (years)	Terr. He (Y/N)	Final (years)	Final Error (years)
CP-16	7/16/1998	1008	nd	nd	nd	nd	Y	nd	nd
CP-17	7/16/1998	1351	nd	nd	nd	nd	nd	nd	nd
CP-18	7/27/1998	1117	nd	nd	nd	nd	Y	nd	nd
CP-19	7/27/1998	1545	77.6	27.4	nd	nd	Y	nd	nd
CP-20	7/28/1998	1102	nd	nd	nd	nd	nd	nd	nd
CP-21	7/29/1998	1059	11.8	0.9	34.5	1.0	Y	34.5	1.0
CP-22	7/30/1998	1048	nd	nd	nd	nd	nd	nd	nd
CP-23	8/3/1998	1126	nd	nd	nd	nd	nd	nd	nd
CP-23d	8/3/1998	1131	nd	nd	nd	nd	nd	nd	nd
CP-24	8/4/1998	936	nd	nd	nd	nd	nd	nd	nd
CP-25	8/4/1998	1440	nd	nd	nd	nd	nd	nd	nd
CP-26	8/5/1998	1325	12.0	0.2	12.5	0.3	N	12.0	0.2
CP-27	8/6/1998	1001	nd	nd	nd	nd	nd	nd	nd
CP-28	8/17/1998	1015	nd	nd	nd	nd	nd	nd	nd
CP-29	8/17/1998	1340	nd	nd	nd	nd	nd	nd	nd
CP-30	8/18/1998	1000	nd	nd	nd	nd	nd	nd	nd
CP-31	8/19/1998	1620	nd	nd	nd	nd	nd	nd	nd
CP-32	8/31/1998	1053	nd	nd	nd	nd	nd	nd	nd
CP-33	8/31/1998	1453	nd	nd	nd	nd	nd	nd	nd
CP-34	8/31/1998	1731	nd	nd	nd	nd	nd	nd	nd
CP-34d	8/31/1998	1736	nd	nd	nd	nd	nd	nd	nd
CP-35	9/1/1998	1038	nd	nd	nd	nd	nd	nd	nd
CP-36	9/1/1998	1545	nd	nd	nd	nd	nd	nd	nd
CP-37	9/2/1998	950	nd	nd	nd	nd	nd	nd	nd
CP-38	9/2/1998	1259	nd	nd	nd	nd	nd	nd	nd
CP-39	9/2/1998	1548	nd	nd	nd	nd	nd	nd	nd
CP-40	9/3/1998	919	nd	nd	nd	nd	nd	nd	nd
CP-41	9/10/1998	1115	nd	nd	nd	nd	nd	nd	nd
CP-42	9/10/1998	1440	nd	nd	nd	nd	nd	nd	nd
CP-43	10/1/1998	1135	nd	nd	nd	nd	nd	nd	nd
CP-44	10/5/1998	1110	nd	nd	nd	nd	nd	nd	nd
CP-45	10/5/1998	1505	20.3	0.5	18.3	0.6	N	20.3	0.5
CP-46	10/6/1998	1020	18.8	0.3	23.2	0.4	Y	23.2	0.4
CP-47	10/6/1998	1430	nd	nd	nd	nd	nd	nd	nd
CP-48	10/7/1998	1027	nd	nd	nd	nd	nd	nd	nd
CP-49	10/27/1998	1025	102.6	78.2	nd	nd	Y	nd	nd
CP-50	10/28/1998	1205	1.9	0.2	3.3	0.5	N	1.9	0.2
CP-51	11/4/1998	1220	nd	nd	nd	nd	nd	nd	nd
CP-51d	11/4/1998	1225	nd	nd	nd	nd	nd	nd	nd
PD-01	6/28/1999	1435	nd	nd	42.6	9.2	Y	42.6	9.2
PD-02	6/29/1999	1530	nd	nd	40.6	0.8	Y	40.6	0.8

Table 14. Summary of apparent tritium/helium-3 ages in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Uncorr., apparent age not corrected for terrigenic helium; Uncorr. Err., one standard deviation age error of uncorrected apparent age; Corr., apparent age corrected for terrigenic helium; Corr. Err., one standard deviation age error of apparent age corrected for terrigenic helium; Terr. He, terrigenic helium; Y, yes, terrigenic helium correction needed; N, no, terrigenic helium correction not needed; nd, not determined. All apparent age calculations based on recharge temperatures determined for the respective samples. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Tritium/Helium-3 ($^3H/^3He$) apparent age						
			Uncorr. (years)	Uncorr. Err. (years)	Corr (years)	Corr Err (years)	Terr. He (Y/N)	Final (years)	Final Error (years)
PD-03	6/30/1999	1030	25.6	0.4	24.5	0.6	N	25.6	0.4
PD-04	6/30/1999	1500	11.4	0.2	21.8	0.5	Y	21.8	0.5
PD-05	7/1/1999	1240	1.5	0.2	15.9	0.5	Y	15.9	0.5
PD-06	8/23/1999	1245	4.9	0.2	10.0	0.3	Y	10.0	0.3
PD-07	8/23/1999	1515	22.2	1.1	31.5	1.3	Y	31.5	1.3
PD-08	8/30/1999	1100	nd	nd	nd	nd	nd	nd	nd
PD-09	8/31/1999	1045	nd	nd	nd	nd	nd	nd	nd
PD-10	9/1/1999	1045	11.0	0.2	11.2	0.1	N	11.0	0.2
PD-11	9/1/1999	1350	16.2	0.3	17.0	0.3	N	16.2	0.3
PD-12	9/1/1999	1720	nd	nd	nd	nd	nd	nd	nd
PD-13	9/2/1999	1030	17.2	0.2	17.7	0.2	N	17.2	0.2
PD-14	9/2/1999	1230	14.6	0.2	15.7	0.2	N	14.6	0.2
PD-15	9/2/1999	1545	12.7	0.2	24.0	0.2	Y	24.0	0.2
PD-15d	9/2/1999	1550	12.5	0.3	23.9	0.2	Y	23.9	0.2
PD-16	9/13/1999	1035	nd	nd	nd	nd	nd	nd	nd
PD-17	9/13/1999	1448	nd	nd	nd	nd	nd	nd	nd
PD-18	10/18/1999	1030	nd	nd	nd	nd	nd	nd	nd
PD-19	10/19/1999	1130	17.7	0.3	19.3	0.3	Y	19.3	0.3
PD-20	10/19/1999	1545	6.3	0.3	17.0	0.2	Y	17.0	0.2
PD-20b	10/20/1999	800	nd	nd	nd	nd	nd	nd	nd
PD-21	10/25/1999	920	nd	nd	nd	nd	nd	nd	nd
PD-22	10/25/1999	1240	nd	nd	nd	nd	nd	nd	nd
PD-23	10/25/1999	1722	nd	nd	nd	nd	nd	nd	nd
PD-24	10/26/1999	1324	nd	nd	nd	nd	nd	nd	nd
PD-25	6/27/2000	1035	24.7	0.2	26.5	0.2	Y	26.5	0.2
PD-26	6/27/2000	1500	nd	nd	nd	nd	nd	nd	nd
PD-27	6/28/2000	920	nd	nd	nd	nd	nd	nd	nd
PD-28	6/28/2000	1440	nd	nd	nd	nd	nd	nd	nd
PD-29	6/29/2000	1130	9.7	0.3	21.6	0.3	Y	21.6	0.3
PD-30	6/29/2000	1540	-22.4	9.5	21.5	1.3	Y	21.5	1.3
VB-01	5/13/1999	1615	nd	nd	nd	nd	nd	nd	nd
VB-02	5/14/1999	1115	nd	nd	nd	nd	nd	nd	nd
VB-03	5/10/1999	1830	nd	nd	nd	nd	nd	nd	nd
VB-04	5/12/1999	1230	nd	nd	nd	nd	nd	nd	nd
VB-05	8/14/2000	1415	nd	nd	nd	nd	nd	nd	nd
VB-05b	8/14/2000	1410	nd	nd	nd	nd	nd	nd	nd
VB-06	8/11/2000	1000	nd	nd	nd	nd	nd	nd	nd
VB-07	8/10/2000	1110	nd	nd	nd	nd	nd	nd	nd
VB-08	8/9/2000	1130	nd	nd	nd	nd	nd	nd	nd
VB-09	8/16/2000	1520	nd	nd	nd	nd	nd	nd	nd
VB-10	8/17/2000	1045	nd	nd	nd	nd	nd	nd	nd

Table 14. Summary of apparent tritium/helium-3 ages in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Uncorr., apparent age not corrected for terrigenic helium; Uncorr. Err., one standard deviation age error of uncorrected apparent age; Corr., apparent age corrected for terrigenic helium; Corr. Err., one standard deviation age error of apparent age corrected for terrigenic helium; Terr. He, terrigenic helium; Y, yes, terrigenic helium correction needed; N, no, terrigenic helium correction not needed; nd, not determined. All apparent age calculations based on recharge temperatures determined for the respective samples. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Tritium/Helium-3 ($^3H/^3He$) apparent age						
			Uncorr. (years)	Uncorr. Err. (years)	Corr (years)	Corr Err (years)	Terr. He (Y/N)	Final (years)	Final Error (years)
VB-11	8/16/2000	945	nd	nd	nd	nd	nd	nd	nd
VB-12	8/15/2000	1115	nd	nd	nd	nd	nd	nd	nd
VB-13	8/8/2000	1225	nd	nd	nd	nd	nd	nd	nd
VB-14	8/7/2000	1745	nd	nd	nd	nd	nd	nd	nd
VB-14d	8/7/2000	1750	nd	nd	nd	nd	nd	nd	nd
VR-01	7/6/1999	1230	nd	nd	nd	nd	Y	nd	nd
VR-02	7/6/1999	1615	9.2	0.3	8.5	1.3	N	9.2	0.3
VR-03	7/7/1999	1035	8.8	0.3	19.1	0.9	Y	19.1	0.9
VR-03d	7/7/1999	1040	8.4	0.3	17.2	0.9	Y	17.2	0.9
VR-04	7/7/1999	1400	nd	nd	nd	nd	Y	nd	nd
VR-05	7/8/1999	1015	6.0	0.2	7.7	0.7	N	6.0	0.2
VR-06	7/8/1999	1620	11.7	0.4	8.0	1.9	N	11.7	0.4
VR-07	7/8/1999	1820	18.2	1.1	18.9	1.2	N	18.2	1.1
VR-08	7/9/1999	1015	nd	nd	43.0	2.1	Y	43.0	2.1
VR-09	7/9/1999	1300	nd	nd	29.7	0.7	Y	29.7	0.7
VR-10	7/9/1999	1500	nd	nd	16.1	1.1	Y	16.1	1.1
VR-11	7/9/1999	1645	nd	nd	-4.0	52.7	N	nd	nd
VR-12	7/21/1999	945	nd	nd	nd	nd	nd	nd	nd
VR-13	7/21/1999	1250	7.2	0.2	7.7	0.2	N	7.2	0.2
VR-14	7/22/1999	1200	18.0	0.5	24.3	0.5	Y	24.3	0.5
VR-15	8/10/1999	1400	nd	nd	nd	nd	nd	nd	nd
VR-15bt	8/10/1999	1405	nd	nd	nd	nd	nd	nd	nd
VR-16	8/11/1999	1330	nd	nd	nd	nd	nd	nd	nd
VR-17	8/11/1999	1630	8.8	0.2	12.4	0.3	Y	12.4	0.3
VR-18	8/12/1999	1130	nd	nd	nd	nd	nd	nd	nd
VR-19	8/24/1999	1050	26.6	0.3	26.3	0.3	N	26.6	0.3
VR-20	8/24/1999	1315	3.6	0.2	4.7	0.3	N	3.6	0.2
VR-21	8/25/1999	1530	12.2	0.2	15.4	0.4	Y	15.4	0.4
VR-22	8/26/1999	925	0.2	0.3	15.7	0.3	Y	15.7	0.3
VR-23	8/26/1999	1400	nd	nd	nd	nd	nd	nd	nd
VR-24	10/27/1999	925	nd	nd	nd	nd	nd	nd	nd
VR-25	10/27/1999	1340	nd	nd	nd	nd	nd	nd	nd
VR-26	10/28/1999	1010	15.0	0.3	17.5	0.3	N	15.0	0.3
VR-27	10/28/1999	1345	nd	nd	nd	nd	nd	nd	nd
VR-28	7/12/2000	1415	2.7	0.3	5.1	0.5	N	2.7	0.3
VR-29	7/13/2000	1108	nd	nd	nd	nd	nd	nd	nd
VR-30	7/13/2000	1415	nd	nd	nd	nd	nd	nd	nd
VR-31	7/17/2000	950	nd	nd	nd	nd	nd	nd	nd
VR-32	7/17/2000	1321	nd	nd	23.5	1.0	Y	23.5	1.0
VR-33	7/18/2000	1030	3.4	0.2	2.3	0.6	N	3.4	0.2
VR-34	7/18/2000	1400	nd	nd	nd	nd	nd	nd	nd

Table 14. Summary of apparent tritium/helium-3 ages in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; Uncorr., apparent age not corrected for terrigenic helium; Uncorr. Err., one standard deviation age error of uncorrected apparent age; Corr., apparent age corrected for terrigenic helium; Corr. Err., one standard deviation age error of apparent age corrected for terrigenic helium; Terr. He, terrigenic helium; Y, yes, terrigenic helium correction needed; N, no, terrigenic helium correction not needed; nd, not determined. All apparent age calculations based on recharge temperatures determined for the respective samples. See figure 1 for location of wells and springs.]

VAS no.	Date	Time	Tritium/Helium-3 ($^3H/^3He$) apparent age						
			Uncorr. (years)	Uncorr. Err. (years)	Corr (years)	Corr Err (years)	Terr. He (Y/N)	Final (years)	Final Error (years)
VR-35	7/19/2000	915	nd	nd	13.3	0.5	Y	13.3	0.5
VR-35b	7/19/2000	1000	nd	nd	nd	nd	nd	nd	nd
VR-36	7/20/2000	1430	0.2	0.2	3.3	0.4	Y	3.3	0.4
VR-37	7/17/2000	950	-5.9	0.8	23.8	0.3	Y	23.8	0.3
VR-37d	7/17/2000	955	-5.7	0.6	26.2	0.6	Y	26.2	0.6
VR-38	7/18/2000	915	11.5	0.2	13.4	0.3	Y	13.4	0.3
VR-39	7/18/2000	1330	17.8	0.3	20.4	0.5	N	17.8	0.3
VR-40	7/19/2000	925	18.6	0.3	20.6	0.7	N	18.6	0.3
VR-41	7/19/2000	1125	nd	nd	nd	nd	nd	nd	nd
VR-42	7/20/2000	1200	-1.2	0.2	-3.8	0.3	Y	nd	nd
VR-42bt	7/20/2000	1205	nd	nd	nd	nd	nd	nd	nd
VR-43	7/20/2000	1740	16.6	0.3	19.0	0.3	Y	19.0	0.3
VR-44	7/20/2000	900	15.3	0.2	15.3	0.2	N	15.3	0.2
VR-45	7/25/2000	920	29.9	0.4	35.3	nd	nd	29.9	0.4
VR-46	7/25/2000	1310	nd	nd	nd	nd	nd	nd	nd
VR-47	7/26/2000	1015	2.5	0.4	12.1	0.3	Y	12.1	0.3
VTDW-01	9/16/1999	1505	2.4	0.2	4.9	0.5	N	2.4	0.2
VTDW-03A	7/15/2000	1300	nd	nd	18.2	0.3	Y	18.2	0.3
VTDW-03B	7/15/2000	1700	nd	nd	20.4	0.4	Y	20.4	0.4
VTDW-07A	7/14/2000	1430	18.8	0.3	26.4	0.3	Y	26.4	0.3
VTDW-07B	7/14/2000	1610	nd	nd	nd	nd	nd	nd	nd
VTDW-08	9/16/1999	1800	2.7	0.2	2.2	0.4	N	2.7	0.2

Table 15. Summary of carbon isotopic data[1] of dissolved inorganic carbon in water samples from wells in the Coastal Plain of Virginia, 1998

[VAS, Virginia Aquifer Susceptibility study; $\delta^{13}C_{DIC}$, carbon-13 of dissolved inorganic carbon; $^{14}C_{DIC}$, carbon-14 of dissolved inorganic carbon; per mil, parts per thousand; 1σ, 1 standard deviation; w/, with; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	$\delta^{13}C_{DIC}$ (per mil)[2]	$D^{14}C_{DIC}$ w/ 1σ (per mil)[3]	$\delta^{14}C_{DIC}$ w/ 1σ (per mil)[4]	$^{14}C_{DIC}$ w/ 1σ (pM)[5]	$^{14}C_{DIC}$ w/ 1σ (pmc)[6]
AP-01	7/10/2000	nd	nd	nd	nd	nd
AP-02	7/10/2000	nd	nd	nd	nd	nd
AP-03	7/20/2000	nd	nd	nd	nd	nd
AP-03d	7/20/2000	nd	nd	nd	nd	nd
AP-04	7/11/2000	nd	nd	nd	nd	nd
AP-05	7/12/2000	nd	nd	nd	nd	nd
AP-06	7/13/2000	nd	nd	nd	nd	nd
AP-07	7/13/2000	nd	nd	nd	nd	nd
AP-08	7/10/2000	nd	nd	nd	nd	nd
AP-09	7/10/2000	nd	nd	nd	nd	nd
AP-10	7/11/2000	nd	nd	nd	nd	nd
AP-11	7/11/2000	nd	nd	nd	nd	nd
AP-12	7/12/2000	nd	nd	nd	nd	nd
AP-13	7/12/2000	nd	nd	nd	nd	nd
BR-01	7/19/1999	nd	nd	nd	nd	nd
BR-02	7/19/1999	nd	nd	nd	nd	nd
BR-03	7/20/1999	nd	nd	nd	nd	nd
BR-04	7/20/1999	nd	nd	nd	nd	nd
BR-05	8/25/1999	nd	nd	nd	nd	nd
BR-06	9/13/1999	nd	nd	nd	nd	nd
BR-07	9/14/1999	nd	nd	nd	nd	nd
BR-08	9/16/1999	nd	nd	nd	nd	nd
BR-09	10/18/1999	nd	nd	nd	nd	nd
BR-10	10/26/1999	nd	nd	nd	nd	nd
CP-01	6/23/1998	-11.8	-988.6 ± 1.1	-988.2 ± 1.1	1.14 ± 0.11	1.18 ± 0.11
CP-01d	6/23/1998	-11.7	-982.8 ± 1.1	-982.3 ± 1.1	1.72 ± 0.11	1.77 ± 0.11
CP-02	6/24/1998	-6.9	-990.7 ± 1.1	-990.4 ± 1.1	0.93 ± 0.11	0.96 ± 0.11
CP-03	6/25/1998	-9.8	-985.4 ± 1.1	-984.9 ± 1.1	1.46 ± 0.11	1.51 ± 0.11
CP-04	7/1/1998	-10.0	-993.5 ± 2.9	-993.3 ± 3.0	0.65 ± 0.29	0.67 ± 0.30
CP-05	7/6/1998	-9.1	-995.6 ± 1.1	-995.4 ± 1.1	0.44 ± 0.11	0.46 ± 0.11
CP-06	7/6/1998	-6.1	-995.6 ± 1.0	-995.4 ± 1.0	0.44 ± 0.10	0.46 ± 0.10
CP-07	7/7/1998	-11.7	-983.2 ± 1.8	-982.7 ± 1.8	1.68 ± 0.18	1.73 ± 0.18
CP-08	7/7/1998	-9.5	-993.9 ± 1.0	-993.7 ± 1.0	0.61 ± 0.10	0.63 ± 0.10
CP-09	7/8/1998	nd	nd	nd	nd	nd
CP-10	7/8/1998	-7.5	-992.6 ± 1.0	-992.3 ± 1.0	0.74 ± 0.11	0.77 ± 0.10
CP-11	7/9/1998	-12.8	-799.1 ± 1.8	-794.0 ± 1.8	20.09 ± 0.18	20.60 ± 0.18
CP-11b	7/9/1998	-12.5	-802.1 ± 1.5	-797.0 ± 1.5	19.79 ± 0.15	20.30 ± 0.15
CP-12	7/14/1998	nd	nd	nd	nd	nd
CP-13	7/15/1998	nd	nd	nd	nd	nd
CP-14	7/15/1998	-16.6	-52.9 ± 6.7	-36.7 ± 6.8	94.71 ± 0.67	96.33 ± 0.68
CP-15	7/15/1998	nd	nd	nd	nd	nd

Table 15. Summary of carbon isotopic data[1] of dissolved inorganic carbon in water samples from wells in the Coastal Plain of Virginia, 1998—Continued

[VAS, Virginia Aquifer Susceptibility study; $\delta^{13}C_{DIC}$, carbon-13 of dissolved inorganic carbon; $^{14}C_{DIC}$, carbon-14 of dissolved inorganic carbon; per mil, parts per thousand; 1σ, 1 standard deviation; w/, with; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	$\delta^{13}C_{DIC}$ (per mil)[2]	$D^{14}C_{DIC}$ w/ 1σ (per mil)[3]	$\delta^{14}C_{DIC}$ w/ 1σ (per mil)[4]	$^{14}C_{DIC}$ w/ 1σ (pM)[5]	$^{14}C_{DIC}$ w/ 1σ (pmc)[6]
CP-16	7/16/1998	nd	nd	nd	nd	nd
CP-17	7/16/1998	nd	nd	nd	nd	nd
CP-18	7/27/1998	-12.5	-807.3 ± 1.7	-802.3 ± 1.7	19.27 ± 0.17	19.77 ± 0.17
CP-19	7/27/1998	-12.9	-798.1 ± 1.8	-793.1 ± 1.8	20.19 ± 0.18	20.69 ± 0.18
CP-20	7/28/1998	-8.7	-995.7 ± 1.0	-995.5 ± 1.0	0.43 ± 0.10	0.45 ± 0.10
CP-21	7/29/1998	-14.8	-401.9 ± 4.2	-389.3 ± 4.3	59.81 ± 0.42	61.07 ± 0.43
CP-22	7/30/1998	-13.6	-753.4 ± 2.5	-747.6 ± 2.5	24.66 ± 0.25	25.24 ± 0.25
CP-23	8/3/1998	-11.7	-949.9 ± 1.3	-948.5 ± 1.3	5.01 ± 0.13	5.15 ± 0.13
CP-23d	8/3/1998	-11.4	-944.8 ± 1.2	-943.2 ± 1.2	5.52 ± 0.12	5.68 ± 0.12
CP-24	8/4/1998	-9.0	-993.9 ± 1.0	-993.7 ± 1.0	0.61 ± 0.10	0.63 ± 0.10
CP-25	8/4/1998	-7.2	-981.9 ± 1.1	-981.2 ± 1.1	1.81 ± 0.11	1.88 ± 0.11
CP-26	8/5/1998	nd	nd	nd	nd	nd
CP-27	8/6/1998	-8.8	-996.3 ± 1.0	-996.2 ± 1.0	0.37 ± 0.10	0.38 ± 0.10
CP-28	8/17/1998	nd	nd	nd	nd	nd
CP-29	8/17/1998	-14.4	-892.1 ± 1.7	-889.7 ± 1.7	10.79 ± 0.17	11.03 ± 0.17
CP-30	8/18/1998	-11.3	-986.2 ± 1.1	-985.8 ± 1.1	1.38 ± 0.11	1.42 ± 0.11
CP-31	8/19/1998	-12.5	-802.1 ± 1.5	-797.0 ± 1.5	19.79 ± 0.15	20.30 ± 0.15
CP-32	8/31/1998	-12.2	-969.5 ± 1.1	-968.6 ± 1.1	3.05 ± 0.11	3.14 ± 0.11
CP-33	8/31/1998	nd	nd	nd	nd	nd
CP-34	8/31/1998	-22.1	-91.3 ± 6.4	-85.8 ± 6.4	90.87 ± 0.64	91.42 ± 0.64
CP-34d	8/31/1998	-21.5	-111.2 ± 8.2	-104.8 ± 8.2	88.88 ± 0.82	89.52 ± 0.82
CP-35	9/1/1998	-12.1	-990.3 ± 1.1	-990.1 ± 1.0	0.97 ± 0.11	0.99 ± 0.10
CP-36	9/1/1998	-9.9	-987.3 ± 1.1	-986.9 ± 1.1	1.27 ± 0.11	1.31 ± 0.11
CP-37	9/2/1998	-14.1	-941.0 ± 1.6	-939.7 ± 1.6	5.90 ± 0.16	6.03 ± 0.16
CP-38	9/2/1998	nd	nd	nd	nd	nd
CP-39	9/2/1998	-15.9	-776.1 ± 2.1	-771.9 ± 2.1	22.39 ± 0.21	22.81 ± 0.21
CP-40	9/3/1998	-10.9	-983.2 ± 1.2	-982.7 ± 1.2	1.68 ± 0.12	1.73 ± 0.12
CP-41	9/10/1998	-9.9	-995.2 ± 1.1	-995.0 ± 1.1	0.48 ± 0.11	0.50 ± 0.11
CP-42	9/10/1998	-7.7	-992.0 ± 1.2	-991.7 ± 1.1	0.80 ± 0.12	0.83 ± 0.11
CP-43	10/1/1998	nd	nd	nd	nd	nd
CP-44	10/5/1998	nd	nd	nd	nd	nd
CP-45	10/5/1998	nd	nd	nd	nd	nd
CP-46	10/6/1998	nd	nd	nd	nd	nd
CP-47	10/6/1998	-11.4	-887.8 ± 1.5	-884.7 ± 1.5	11.22 ± 0.15	11.53 ± 0.15
CP-48	10/7/1998	nd	nd	nd	nd	nd
CP-49	10/27/1998	nd	nd	nd	nd	nd
CP-50	10/28/1998	nd	nd	nd	nd	nd
CP-51	11/4/1998	-10.1	-996.5 ± 1.0	-996.4 ± 1.0	0.35 ± 0.10	0.36 ± 0.10
CP-51d	11/4/1998	-9.8	-971.2 ± 1.2	-970.3 ± 1.2	2.88 ± 0.12	2.97 ± 0.12
PD-01	6/28/1999	nd	nd	nd	nd	nd
PD-02	6/29/1999	nd	nd	nd	nd	nd
PD-03	6/30/1999	nd	nd	nd	nd	nd

Table 15. Summary of carbon isotopic data[1] of dissolved inorganic carbon in water samples from wells in the Coastal Plain of Virginia, 1998—Continued

[VAS, Virginia Aquifer Susceptibility study; $\delta^{13}C_{DIC}$, carbon-13 of dissolved inorganic carbon; $^{14}C_{DIC}$, carbon-14 of dissolved inorganic carbon; per mil, parts per thousand; 1σ, 1 standard deviation; w/, with; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	$\delta^{13}C_{DIC}$ (per mil)[2]	$D^{14}C_{DIC}$ w/ 1σ (per mil)[3]	$\delta^{14}C_{DIC}$ w/ 1σ (per mil)[4]	$^{14}C_{DIC}$ w/ 1σ (pM)[5]	$^{14}C_{DIC}$ w/ 1σ (pmc)[6]
PD-04	6/30/1999	nd	nd	nd	nd	nd
PD-05	7/1/1999	nd	nd	nd	nd	nd
PD-06	8/23/1999	nd	nd	nd	nd	nd
PD-07	8/23/1999	nd	nd	nd	nd	nd
PD-08	8/30/1999	nd	nd	nd	nd	nd
PD-09	8/31/1999	nd	nd	nd	nd	nd
PD-10	9/1/1999	nd	nd	nd	nd	nd
PD-11	9/1/1999	nd	nd	nd	nd	nd
PD-12	9/1/1999	nd	nd	nd	nd	nd
PD-13	9/2/1999	nd	nd	nd	nd	nd
PD-14	9/2/1999	nd	nd	nd	nd	nd
PD-15	9/2/1999	nd	nd	nd	nd	nd
PD-15d	9/2/1999	nd	nd	nd	nd	nd
PD-16	9/13/1999	nd	nd	nd	nd	nd
PD-17	9/13/1999	nd	nd	nd	nd	nd
PD-18	10/18/1999	nd	nd	nd	nd	nd
PD-19	10/19/1999	nd	nd	nd	nd	nd
PD-20	10/19/1999	nd	nd	nd	nd	nd
PD-20b	10/20/1999	nd	nd	nd	nd	nd
PD-21	10/25/1999	nd	nd	nd	nd	nd
PD-22	10/25/1999	nd	nd	nd	nd	nd
PD-23	10/25/1999	nd	nd	nd	nd	nd
PD-24	10/26/1999	nd	nd	nd	nd	nd
PD-25	6/27/2000	nd	nd	nd	nd	nd
PD-26	6/27/2000	nd	nd	nd	nd	nd
PD-27	6/28/2000	nd	nd	nd	nd	nd
PD-28	6/28/2000	nd	nd	nd	nd	nd
PD-29	6/29/2000	nd	nd	nd	nd	nd
PD-30	6/29/2000	nd	nd	nd	nd	nd
VB-01	5/13/1999	nd	nd	nd	nd	nd
VB-02	5/14/1999	nd	nd	nd	nd	nd
VB-03	5/10/1999	nd	nd	nd	nd	nd
VB-04	5/12/1999	nd	nd	nd	nd	nd
VB-05	8/14/2000	nd	nd	nd	nd	nd
VB-05b	8/14/2000	nd	nd	nd	nd	nd
VB-06	8/11/2000	nd	nd	nd	nd	nd
VB-07	8/10/2000	nd	nd	nd	nd	nd
VB-08	8/9/2000	nd	nd	nd	nd	nd
VB-09	8/16/2000	nd	nd	nd	nd	nd
VB-10	8/17/2000	nd	nd	nd	nd	nd
VB-11	8/16/2000	nd	nd	nd	nd	nd
VB-12	8/15/2000	nd	nd	nd	nd	nd

Table 15. Summary of carbon isotopic data[1] of dissolved inorganic carbon in water samples from wells in the Coastal Plain of Virginia, 1998—Continued

[VAS, Virginia Aquifer Susceptibility study; $\delta^{13}C_{DIC}$, carbon-13 of dissolved inorganic carbon; $^{14}C_{DIC}$, carbon-14 of dissolved inorganic carbon; per mil, parts per thousand; 1σ, 1 standard deviation; w/, with; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	$\delta^{13}C_{DIC}$ (per mil)[2]	$D^{14}C_{DIC}$ w/ 1σ (per mil)[3]	$\delta^{14}C_{DIC}$ w/ 1σ (per mil)[4]	$^{14}C_{DIC}$ w/ 1σ (pM)[5]	$^{14}C_{DIC}$ w/ 1σ (pmc)[6]
VB-13	8/8/2000	nd	nd	nd	nd	nd
VB-14	8/7/2000	nd	nd	nd	nd	nd
VB-14d	8/7/2000	nd	nd	nd	nd	nd
VR-01	7/6/1999	nd	nd	nd	nd	nd
VR-02	7/6/1999	nd	nd	nd	nd	nd
VR-03	7/7/1999	nd	nd	nd	nd	nd
VR-03d	7/7/1999	nd	nd	nd	nd	nd
VR-04	7/7/1999	nd	nd	nd	nd	nd
VR-05	7/8/1999	nd	nd	nd	nd	nd
VR-06	7/8/1999	nd	nd	nd	nd	nd
VR-07	7/8/1999	nd	nd	nd	nd	nd
VR-08	7/9/1999	nd	nd	nd	nd	nd
VR-09	7/9/1999	nd	nd	nd	nd	nd
VR-10	7/9/1999	nd	nd	nd	nd	nd
VR-11	7/9/1999	nd	nd	nd	nd	nd
VR-12	7/21/1999	nd	nd	nd	nd	nd
VR-13	7/21/1999	nd	nd	nd	nd	nd
VR-14	7/22/1999	nd	nd	nd	nd	nd
VR-15	8/10/1999	nd	nd	nd	nd	nd
VR-15bt	8/10/1999	nd	nd	nd	nd	nd
VR-16	8/11/1999	nd	nd	nd	nd	nd
VR-17	8/11/1999	nd	nd	nd	nd	nd
VR-18	8/12/1999	nd	nd	nd	nd	nd
VR-19	8/24/1999	nd	nd	nd	nd	nd
VR-20	8/24/1999	nd	nd	nd	nd	nd
VR-21	8/25/1999	nd	nd	nd	nd	nd
VR-22	8/26/1999	nd	nd	nd	nd	nd
VR-23	8/26/1999	nd	nd	nd	nd	nd
VR-24	10/27/1999	nd	nd	nd	nd	nd
VR-25	10/27/1999	nd	nd	nd	nd	nd
VR-26	10/28/1999	nd	nd	nd	nd	nd
VR-27	10/28/1999	nd	nd	nd	nd	nd
VR-28	7/12/2000	nd	nd	nd	nd	nd
VR-29	7/13/2000	nd	nd	nd	nd	nd
VR-30	7/13/2000	nd	nd	nd	nd	nd
VR-31	7/17/2000	nd	nd	nd	nd	nd
VR-32	7/17/2000	nd	nd	nd	nd	nd
VR-33	7/18/2000	nd	nd	nd	nd	nd
VR-34	7/18/2000	nd	nd	nd	nd	nd
VR-35	7/19/2000	nd	nd	nd	nd	nd
VR-35b	7/19/2000	nd	nd	nd	nd	nd
VR-36	7/20/2000	nd	nd	nd	nd	nd

Table 15. Summary of carbon isotopic data[1] of dissolved inorganic carbon in water samples from wells in the Coastal Plain of Virginia, 1998—Continued

[VAS, Virginia Aquifer Susceptibility study; $\delta^{13}C_{DIC}$, carbon-13 of dissolved inorganic carbon; $^{14}C_{DIC}$, carbon-14 of dissolved inorganic carbon; per mil, parts per thousand; 1σ, 1 standard deviation; w/, with; nd, not determined. See figure 1 for location of wells and springs.]

VAS no.	Date	$\delta^{13}C_{DIC}$ (per mil)[2]	$D^{14}C_{DIC}$ w/ 1σ (per mil)[3]	$\delta^{14}C_{DIC}$ w/ 1σ (per mil)[4]	$^{14}C_{DIC}$ w/ 1σ (pM)[5]	$^{14}C_{DIC}$ w/ 1σ (pmc)[6]
VR-37	7/17/2000	nd	nd	nd	nd	nd
VR-37d	7/17/2000	nd	nd	nd	nd	nd
VR-38	7/18/2000	nd	nd	nd	nd	nd
VR-39	7/18/2000	nd	nd	nd	nd	nd
VR-40	7/19/2000	nd	nd	nd	nd	nd
VR-41	7/19/2000	nd	nd	nd	nd	nd
VR-42	7/20/2000	nd	nd	nd	nd	nd
VR-42bt	7/20/2000	nd	nd	nd	nd	nd
VR-43	7/20/2000	nd	nd	nd	nd	nd
VR-44	7/20/2000	nd	nd	nd	nd	nd
VR-45	7/25/2000	nd	nd	nd	nd	nd
VR-46	7/25/2000	nd	nd	nd	nd	nd
VR-47	7/26/2000	nd	nd	nd	nd	nd
VTDW-01	9/16/1999	nd	nd	nd	nd	nd
VTDW-03A	7/15/2000	nd	nd	nd	nd	nd
VTDW-03B	7/15/2000	nd	nd	nd	nd	nd
VTDW-07A	7/14/2000	nd	nd	nd	nd	nd
VTDW-07B	7/14/2000	nd	nd	nd	nd	nd
VTDW-08	9/16/1999	nd	nd	nd	nd	nd

[1] Water samples for the determination of $\delta^{13}C$ in the Environmental Isotope Laboratory of the Department of Earth Sciences at University of Waterloo, Waterloo, Ontario, Canada were analyzed by mass spectrometric analysis. Water samples for the determination of ^{14}C activity in the Rafter Radiocarbon Laboratory, Institute of Geological and Nuclear Sciences Ltd., Lower Hutt, New Zealand were analyzed by accelerator mass spectrometry (AMS).

[2] $\delta^{13}C$ is reported in per mil relative to the Vienna Peedee belemnite (VPDB) standard (Coplen, 1994).

[3] $D^{14}C_{DIC}$, per mil depletion or enrichment of $^{14}C_{DIC}$ relative to the former NBS I oxalic acid standard, normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950.

[4] $\delta^{14}C_{DIC}$, per mil depletion or enrichment of $^{14}C_{DIC}$ relative to the former NBS I oxalic acid standard, not normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950.

[5] pM, Absolute percent Modern carbon relative to the former NBS I oxalic acid standard, normalized for 13C isotopic fractionation, and corrected for decay since 1950.

[6] pmc, percent modern carbon relative to the former NBS I oxalic acid standard, not normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950.

Table 16. Summary of radiocarbon ages[1] of dissolved inorganic carbon in water samples from wells in the Coastal Plain of Virginia, 1998

[VAS, Virginia Aquifer Susceptibility study; ^{14}C, carbon-14; pM, Absolute percent Modern relative to the former NBS I oxalic acid standard, normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950; ^{14}C Age, conventional radiocarbon age in radiocarbon years BP (present is 1950); pmc, percent modern carbon relative to the former NBS I oxalic acid standard, not normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950; A_0, initial ^{14}C activity; TDC, total dissolved carbon; ^{14}C Adj. age, adjusted radiocarbon age in radiocarbon years BP (present is AD 1950); nd, not determined. All ^{14}C ages are based on the Libby half-life of 5,568 years and have not been calibrated to calendar years.]

VAS no.	Date	^{14}C Age w/ 1σ (years)	Selected inorganic carbon adjustment models[2]									
			Fontes-Garnier		Tamers		Ingerson-Pearson		Mook		Eichinger	
			A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)
AP-01	7/10/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
AP-02	7/10/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
AP-03	7/20/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
AP-03d	7/20/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
AP-04	7/11/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
AP-05	7/12/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
AP-06	7/13/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
AP-07	7/13/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
AP-08	7/10/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
AP-09	7/10/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
AP-10	7/11/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
AP-11	7/11/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
AP-12	7/12/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
AP-13	7/12/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BR-01	7/19/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BR-02	7/19/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BR-03	7/20/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BR-04	7/20/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BR-05	8/25/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BR-06	9/13/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BR-07	9/14/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BR-08	9/16/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BR-09	10/18/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BR-10	10/26/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CP-01	6/23/1998	35,870 ± 770	61.31	31,801	54.61	30,872	58.47	31,420	60.06	31,636	55.63	31,020

Table 16. Summary of radiocarbon ages[1] of dissolved inorganic carbon in water samples from wells in the Coastal Plain of Virginia, 1998—Continued

[VAS, Virginia Aquifer Susceptibility study; ^{14}C, carbon-14; pM, Absolute percent Modern relative to the former NBS I oxalic acid standard, normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950; ^{14}C Age, conventional radiocarbon age in radiocarbon years BP (present is 1950); pmc, percent modern carbon relative to the former NBS I oxalic acid standard, not normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950; A_0, initial ^{14}C activity; TDC, total dissolved carbon; ^{14}C Adj. age, adjusted radiocarbon age in radiocarbon years BP (present is AD 1950); nd, not determined. All ^{14}C ages are based on the Libby half-life of 5,568 years and have not been calibrated to calendar years.]

VAS no.	Date	^{14}C Age w/ 1σ (years)	Selected inorganic carbon adjustment models[2]									
			Fontes-Garnier		Tamers		Ingerson-Pearson		Mook		Eichinger	
			A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)
CP-01d	6/23/1998	32,570 ± 520	60.62	28,683	54.61	27,844	58.07	28,338	57	28,189	55.19	27,929
CP-02	6/24/1998	37,540 ± 940	33.75	28,667	50.16	31,852	34.28	28,792	nd	nd	31.22	28,040
CP-03	6/25/1998	33,880 ± 620	48.41	27,939	52.7	28,622	48.59	27,968	2.7	4,744	45.19	27,385
CP-04	7/1/1998	40,400 ± 3,600	49.59	34,646	50.48	34,789	49.63	34,652	24.39	28,943	46.78	34,177
CP-05	7/6/1998	43,500 ± 2,000	44.71	36,901	49.63	37,739	44.94	36,942	7.6	22,662	41.98	36,394
CP-06	7/6/1998	43,500 ± 1,900	29.13	33,367	50.26	37,751	30.32	33,689	nd	nd	26.16	32,505
CP-07	7/7/1998	32,780 ± 870	63.03	28,997	50.62	27,235	57.93	28,318	80.89	31,001	55.49	27,973
CP-08	7/7/1998	41,000 ± 1,400	46.95	34,727	50.03	35,236	47.05	34,742	nd	nd	44.24	34,247
CP-09	7/8/1998	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CP-10	7/8/1998	39,400 ± 1,100	36.48	31,137	49.84	33,645	36.92	31,233	nd	nd	33.87	30,541
CP-11	7/9/1998	12,844 ± 73	71.1	10,056	53.58	7,783	63.14	9,103	142.46	15,641	60.66	8,781
CP-11b	7/9/1998	12,968 ± 62	68.91	10,110	53.69	8,105	62	9,259	124.59	14,868	59.43	8,919
CP-12	7/14/1998	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CP-13	7/15/1998	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CP-14	7/15/1998	389 ± 57	82.34	-1,199	92.37	-276	82.57	-1,177	nd	nd	66.03	-2,973
CP-15	7/15/1998	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CP-16	7/16/1998	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CP-17	7/16/1998	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CP-18	7/27/1998	13,178 ± 72	69.48	10,132	53.19	7,986	62.14	9,236	127.05	14,981	59.58	8,898
CP-19	7/27/1998	12,806 ± 70	69.69	9,790	57.4	8,233	64.24	9,136	91.57	11,985	61.63	8,803
CP-20	7/28/1998	43,700 ± 1,900	42.77	36,629	50.84	38,017	43.07	36,684	nd	nd	39.95	36,080
CP-21	7/29/1998	4,081 ± 57	79.24	2,418	60.88	301	71.01	1,538	133.08	6,585	69.33	1,345
CP-22	7/30/1998	11,200 ± 81	77.86	9,089	55	6,298	67.63	7,958	166.18	15,182	65.53	7,705
CP-23	8/3/1998	24,000 ± 200	62.87	20,232	50.61	18,489	57.43	19,505	95.52	23,593	54.78	19,126
CP-23d	8/3/1998	23,220 ± 180	60.38	19,328	50.75	17,931	56.1	18,738	79.57	21,546	53.41	18,343

Table 16. Summary of radiocarbon ages[1] of dissolved inorganic carbon in water samples from wells in the Coastal Plain of Virginia, 1998—Continued

[VAS, Virginia Aquifer Susceptibility study; ^{14}C, carbon-14; pM, Absolute percent Modern relative to the former NBS I oxalic acid standard, normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950; ^{14}C Age, conventional radiocarbon age in radiocarbon years BP (present is 1950); pmc, percent modern carbon relative to the former NBS I oxalic acid standard, not normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950; A_0, initial ^{14}C activity; TDC, total dissolved carbon; ^{14}C Adj. age, adjusted radiocarbon age in radiocarbon years BP (present is AD 1950); nd, not determined. All ^{14}C ages are based on the Libby half-life of 5,568 years and have not been calibrated to calendar years.]

VAS no.	Date	^{14}C Age w/ 1σ (years)	Selected inorganic carbon adjustment models[2]									
			Fontes-Garnier		Tamers		Ingerson-Pearson		Mook		Eichinger	
			A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)
CP-24	8/4/1998	40,900 ± 1,400	44.33	34,219	50.61	35,285	44.53	34,255	nd	nd	41.58	33,704
CP-25	8/4/1998	32,180 ± 480	35.19	23,610	50.28	26,478	35.58	23,699	nd	nd	32.66	23,011
CP-26	8/5/1998	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CP-27	8/6/1998	45,000 ± 2,300	43.32	38,097	51.28	39,452	43.63	38,154	nd	nd	40.36	37,527
CP-28	8/17/1998	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CP-29	8/17/1998	17,830 ± 120	87.6	16,721	51.37	12,432	71.22	15,057	278.17	26,005	68.88	14,789
CP-30	8/18/1998	34,350 ± 630	59.12	30,028	51.88	28,977	55.85	29,570	66.28	30,947	53.04	29,155
CP-31	8/19/1998	12,968 ± 62	70.71	10,097	51.88	7,609	62.11	9,055	162.47	16,782	59.5	8,710
CP-32	8/31/1998	27,980 ± 300	68.69	24,841	50.26	22,332	60.47	23,818	139.69	30,545	57.8	23,455
CP-33	8/31/1998	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CP-34	8/31/1998	721 ± 56	119.58	2,429	91.21	253	106.64	1,509	242.45	8,107	109.81	1,744
CP-34d	8/31/1998	900 ± 74	117.42	2,301	93.6	479	106.55	1,521	206.08	6,821	107.54	1,595
CP-35	9/1/1998	37,210 ± 880	66.92	33,913	51.39	31,791	59.97	33,032	118.87	38,530	57.34	32,673
CP-36	9/1/1998	35,030 ± 700	48.89	29,136	50.6	29,412	48.94	29,143	nd	nd	46.11	28,664
CP-37	9/2/1998	22,690 ± 220	82.54	21,100	53.73	17,651	69.74	19,746	196.07	28,052	67.85	19,525
CP-38	9/2/1998	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CP-39	9/2/1998	11,975 ± 74	99.57	11,910	53.8	6,963	78.92	10,043	337.11	21,710	77.62	9,909
CP-40	9/3/1998	32,760 ± 570	55.94	27,995	51.35	27,307	53.92	27,700	49.12	26,951	51.12	27,271
CP-41	9/10/1998	42,800 ± 1,800	49.13	36,912	51.45	37,282	49.2	36,922	nd	nd	46.21	36,420
CP-42	9/10/1998	38,800 ± 1,200	38.04	30,757	50.4	33,017	38.49	30,851	nd	nd	35.39	30,176
CP-43	10/1/1998	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CP-44	10/5/1998	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CP-45	10/5/1998	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CP-46	10/6/1998	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CP-47	10/6/1998	17,530 ± 110	60.92	13,473	50.52	11,967	56.32	12,841	84.15	16,068	53.64	12,449

Table 16. Summary of radiocarbon ages[1] of dissolved inorganic carbon in water samples from wells in the Coastal Plain of Virginia, 1998—Continued

[VAS, Virginia Aquifer Susceptibility study; ^{14}C, carbon-14; pM, Absolute percent Modern relative to the former NBS I oxalic acid standard, normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950; ^{14}C Age, conventional radiocarbon age in radiocarbon years BP (present is 1950); pmc, percent modern carbon relative to the former NBS I oxalic acid standard, not normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950; A_0, initial ^{14}C activity; TDC, total dissolved carbon; ^{14}C Adj. age, adjusted radiocarbon age in radiocarbon years BP (present is AD 1950); nd, not determined. All ^{14}C ages are based on the Libby half-life of 5,568 years and have not been calibrated to calendar years.]

VAS no.	Date	^{14}C Age w/ 1σ (years)	Selected inorganic carbon adjustment models[2]									
			Fontes-Garnier		Tamers		Ingerson-Pearson		Mook		Eichinger	
			A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)
CP-48	10/7/1998	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CP-49	10/27/1998	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CP-50	10/28/1998	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CP-51	11/4/1998	45,500 ± 2,400	50.36	39,701	53.28	40,154	50.5	39,723	14.93	29,932	47.14	39,170
CP-51d	11/4/1998	28,460 ± 340	48.67	22,755	53.04	23,446	48.88	22,789	6.39	6,442	45.4	22,195
PD-01	6/28/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-02	6/29/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-03	6/30/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-04	6/30/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-05	7/1/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-06	8/23/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-07	8/23/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-08	8/30/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-09	8/31/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-10	9/1/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-11	9/1/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-12	9/1/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-13	9/2/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-14	9/2/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-15	9/2/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-15d	9/2/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-16	9/13/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-17	9/13/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-18	10/18/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-19	10/19/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Table 16. Summary of radiocarbon ages[1] of dissolved inorganic carbon in water samples from wells in the Coastal Plain of Virginia, 1998—Continued

[VAS, Virginia Aquifer Susceptibility study; ^{14}C, carbon-14; pM, Absolute percent Modern relative to the former NBS I oxalic acid standard, normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950; ^{14}C Age, conventional radiocarbon age in radiocarbon years BP (present is 1950); pmc, percent modern carbon relative to the former NBS I oxalic acid standard, not normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950; A_0, initial ^{14}C activity; TDC, total dissolved carbon; ^{14}C Adj. age, adjusted radiocarbon age in radiocarbon years BP (present is AD 1950); nd, not determined. All ^{14}C ages are based on the Libby half-life of 5,568 years and have not been calibrated to calendar years.]

VAS no.	Date	^{14}C Age w/ 1σ (years)	Selected inorganic carbon adjustment models[2]									
			Fontes-Garnier		Tamers		Ingerson-Pearson		Mook		Eichinger	
			A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)
PD-20	10/19/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-20b	10/20/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-21	10/25/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-22	10/25/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-23	10/25/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-24	10/26/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-25	6/27/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-26	6/27/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-27	6/28/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-28	6/28/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-29	6/29/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PD-30	6/29/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VB-01	5/13/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VB-02	5/14/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VB-03	5/10/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VB-04	5/12/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VB-05	8/14/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VB-05b	8/14/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VB-06	8/11/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VB-07	8/10/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VB-08	8/9/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VB-09	8/16/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VB-10	8/17/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VB-11	8/16/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VB-12	8/15/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Table 16. Summary of radiocarbon ages[1] of dissolved inorganic carbon in water samples from wells in the Coastal Plain of Virginia, 1998—Continued

[VAS, Virginia Aquifer Susceptibility study; ^{14}C, carbon-14; pM, Absolute percent Modern relative to the former NBS I oxalic acid standard, normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950; ^{14}C Age, conventional radiocarbon age in radiocarbon years BP (present is 1950); pmc, percent modern carbon relative to the former NBS I oxalic acid standard, not normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950; A_0, initial ^{14}C activity; TDC, total dissolved carbon; ^{14}C Adj. age, adjusted radiocarbon age in radiocarbon years BP (present is AD 1950); nd, not determined. All ^{14}C ages are based on the Libby half-life of 5,568 years and have not been calibrated to calendar years.]

VAS no.	Date	^{14}C Age w/ 1σ (years)	Selected inorganic carbon adjustment models[2]									
			Fontes-Garnier		Tamers		Ingerson-Pearson		Mook		Eichinger	
			A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)
VB-13	8/8/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VB-14	8/7/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VB-14d	8/7/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-01	7/6/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-02	7/6/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-03	7/7/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-03d	7/7/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-04	7/7/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-05	7/8/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-06	7/8/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-07	7/8/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-08	7/9/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-09	7/9/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-10	7/9/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-11	7/9/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-12	7/21/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-13	7/21/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-14	7/22/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-15	8/10/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-15bt	8/10/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-16	8/11/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-17	8/11/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-18	8/12/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-19	8/24/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-20	8/24/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Table 16. Summary of radiocarbon ages[1] of dissolved inorganic carbon in water samples from wells in the Coastal Plain of Virginia, 1998—Continued

[VAS, Virginia Aquifer Susceptibility study; ^{14}C, carbon-14; pM, Absolute percent Modern relative to the former NBS I oxalic acid standard, normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950; ^{14}C Age, conventional radiocarbon age in radiocarbon years BP (present is 1950); pmc, percent modern carbon relative to the former NBS I oxalic acid standard, not normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950; A_0, initial ^{14}C activity; TDC, total dissolved carbon; ^{14}C Adj. age, adjusted radiocarbon age in radiocarbon years BP (present is AD 1950); nd, not determined. All ^{14}C ages are based on the Libby half-life of 5,568 years and have not been calibrated to calendar years.]

VAS no.	Date	^{14}C Age w/ 1σ (years)	Selected inorganic carbon adjustment models[2]									
			Fontes-Garnier		Tamers		Ingerson-Pearson		Mook		Eichinger	
			A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)
VR-21	8/25/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-22	8/26/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-23	8/26/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-24	10/27/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-25	10/27/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-26	10/28/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-27	10/28/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-28	7/12/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-29	7/13/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-30	7/13/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-31	7/17/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-32	7/17/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-33	7/18/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-34	7/18/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-35	7/19/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-35b	7/19/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-36	7/20/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-37	7/17/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-37d	7/17/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-38	7/18/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-39	7/18/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-40	7/19/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-41	7/19/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-42	7/20/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-42bt	7/20/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Table 16. Summary of radiocarbon ages[1] of dissolved inorganic carbon in water samples from wells in the Coastal Plain of Virginia, 1998—Continued

[VAS, Virginia Aquifer Susceptibility study; ^{14}C, carbon-14; pM, Absolute percent Modern relative to the former NBS I oxalic acid standard, normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950; ^{14}C Age, conventional radiocarbon age in radiocarbon years BP (present is 1950); pmc, percent modern carbon relative to the former NBS I oxalic acid standard, not normalized for ^{13}C isotopic fractionation, and corrected for decay since 1950; A_0, initial ^{14}C activity; TDC, total dissolved carbon; ^{14}C Adj. age, adjusted radiocarbon age in radiocarbon years BP (present is AD 1950); nd, not determined. All ^{14}C ages are based on the Libby half-life of 5,568 years and have not been calibrated to calendar years.]

VAS no.	Date	^{14}C Age w/ 1σ (years)	Selected inorganic carbon adjustment models[2]									
			Fontes-Garnier		Tamers		Ingerson-Pearson		Mook		Eichinger	
			A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)	A_O TDC (pmc)	^{14}C Adj age (years)
VR-43	7/20/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-44	7/20/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-45	7/25/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-46	7/25/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VR-47	7/26/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VTDW-01	9/16/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VTDW-03A	7/15/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VTDW-03B	7/15/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VTDW-07A	7/14/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VTDW-07B	7/14/2000	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
VTDW-08	9/16/1999	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

[1] Water samples for the determination of ^{14}C activity in the Rafter Radiocarbon Laboratory, Institute of Geological and Nuclear Sciences Ltd., Lower Hutt, New Zealand were analyzed by accelerator mass spectrometry (AMS).

[2] Inorganic carbon adjustment models used are Fontes and Garnier (1979), Tamers (1975), Ingerson and Pearson (1964), Mook (1972), and Eichinger (1983).The following initial conditions were assumed for each adjustment model: (1) ^{14}C activity in carbonate minerals of 0 pmc, (2) ^{14}C activity in soil gas CO2 of 100 pmc, (3) $\delta^{13}C$ in carbonate minerals of 0 ‰ relative to VPDB, and (4) $\delta^{13}C$ in soil gas CO2 of -20 ‰ relative to VPDB.

Table 17. Summary of oxygen ($\delta^{18}O$) and hydrogen ($\delta^{2}H$) isotopic data in water samples from wells and springs in Virginia, 1998-2000

[VAS, Virginia Aquifer Susceptibility study; per mil, parts per thousand; $\delta=((R_{sample}/R_{standard})-1)x1000$, where R is an isotope ratio; 2σ, 2 standard deviations; The 2σ precision of oxygen- and hydrogen-isotope results is 0.2 and 1.5 per mil, respectively. ***d***, deuterium excess; nd, not determined]

VAS no.	Date	Time	$\delta^{18}O$ (per mil)[1]	$\delta^{2}H$ (per mil)[1]	*d* (per mil)[2]
AP-01	7/10/2000	1045	-7.3	-47.3	11.5
AP-02	7/10/2000	1400	-7.3	-46.8	11.8
AP-03	7/20/2000	1045	-7.9	-48.1	14.9
AP-03d	7/20/2000	1050	-7.8	-49.6	13.0
AP-04	7/11/2000	1050	-7.5	-44.9	15.2
AP-05	7/12/2000	950	-7.4	-46.3	13.2
AP-06	7/13/2000	905	-7.6	-46.1	14.6
AP-07	7/13/2000	1445	-7.6	-47.6	13.1
AP-08	7/10/2000	950	-8.4	-51.6	15.6
AP-09	7/10/2000	1345	-8.1	-50.9	13.6
AP-10	7/11/2000	1115	-7.3	-46.1	12.6
AP-11	7/11/2000	1530	-7.3	-45.2	12.9
AP-12	7/12/2000	1140	-7.7	-48.7	12.8
AP-13	7/12/2000	1430	-7.5	-45.6	14.5
BR-01	7/19/1999	1100	-7.1	-42.6	14.1
BR-02	7/19/1999	1500	-7.0	-42.1	13.5
BR-03	7/20/1999	910	-8.1	-49.1	15.6
BR-04	7/20/1999	1425	-6.9	-40.2	14.8
BR-05	8/25/1999	1115	-7.7	-46.6	14.7
BR-06	9/13/1999	1715	-7.4	-44.4	14.4
BR-07	9/14/1999	940	-7.6	-44.6	16.0
BR-08	9/16/1999	940	-7.4	-45.2	14.3
BR-09	10/18/1999	1720	-6.8	-39.7	14.3
BR-10	10/26/1999	947	-7.3	-45.2	12.9
CP-01	6/23/1998	1338	-7.3	-41.9	16.4
CP-01d	6/23/1998	1342	-7.3	-42.8	15.4
CP-02	6/24/1998	1142	-6.1	-32.1	16.4
CP-03	6/25/1998	1231	-7.2	-42.0	15.2
CP-04	7/1/1998	1024	-7.1	-41.1	15.5
CP-05	7/6/1998	1213	-6.6	-36.6	16.3
CP-06	7/6/1998	1434	-6.7	-33.6	20.1
CP-07	7/7/1998	1158	-7.2	-40.9	16.4
CP-08	7/7/1998	1459	-7.0	-38.9	17.5
CP-09	7/8/1998	1159	-5.5	-28.4	16.0
CP-10	7/8/1998	1505	-6.6	-38.8	14.3
CP-11	7/9/1998	1121	-6.1	-35.3	13.5
CP-11b	7/9/1998	1126	-6.2	-34.3	14.9
CP-12	7/14/1998	1327	-6.3	-36.2	14.2
CP-13	7/15/1998	920	-5.4	-30.0	13.4
CP-14	7/15/1998	1220	-6.1	-34.5	14.1
CP-15	7/15/1998	1410	-5.4	-29.3	13.5
CP-16	7/16/1998	1008	-5.9	-33.5	13.7

Table 17. Summary of oxygen ($\delta^{18}O$) and hydrogen ($\delta^{2}H$) isotopic data in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; per mil, parts per thousand; $\delta=((R_{sample}/R_{standard})-1)x1000$, where R is an isotope ratio; 2σ, 2 standard deviations; The 2σ precision of oxygen- and hydrogen-isotope results is 0.2 and 1.5 per mil, respectively. ***d***, deuterium excess; nd, not determined]

VAS no.	Date	Time	$\delta^{18}O$ (per mil)[1]	$\delta^{2}H$ (per mil)[1]	*d* (per mil)[2]
CP-17	7/16/1998	1351	-5.8	-31.8	14.6
CP-18	7/27/1998	1117	-5.8	-31.9	14.4
CP-19	7/27/1998	1545	-5.6	-30.5	14.4
CP-20	7/28/1998	1102	-5.8	-32.3	14.5
CP-21	7/29/1998	1059	-5.5	-29.6	14.8
CP-22	7/30/1998	1048	-5.4	-27.4	16.2
CP-23	8/3/1998	1126	-7.1	-41.2	15.4
CP-23d	8/3/1998	1131	-7.1	-40.1	16.8
CP-24	8/4/1998	936	-6.5	-37.1	14.5
CP-25	8/4/1998	1440	-6.1	-33.2	15.8
CP-26	8/5/1998	1325	-6.1	-34.0	15.1
CP-27	8/6/1998	1001	-6.9	-39.8	15.0
CP-28	8/17/1998	1015	-6.7	-38.3	15.5
CP-29	8/17/1998	1340	-7.4	-43.3	15.8
CP-30	8/18/1998	1000	-8.1	-47.7	16.9
CP-31	8/19/1998	1620	-7.6	-45.1	15.9
CP-32	8/31/1998	1053	-5.9	-30.4	16.9
CP-33	8/31/1998	1453	-6.1	-33.8	15.0
CP-34	8/31/1998	1731	-6.0	-34.1	14.3
CP-34d	8/31/1998	1736	-6.0	-33.0	15.0
CP-35	9/1/1998	1038	-7.4	-45.4	13.9
CP-36	9/1/1998	1545	-6.4	-36.4	14.9
CP-37	9/2/1998	950	-6.7	-39.3	14.4
CP-38	9/2/1998	1259	-6.9	-41.6	14.0
CP-39	9/2/1998	1548	-6.2	-34.8	14.8
CP-40	9/3/1998	919	-6.8	-40.9	13.7
CP-41	9/10/1998	1115	-7.1	-42.3	14.3
CP-42	9/10/1998	1440	-7.1	-42.9	14.1
CP-43	10/1/1998	1135	-6.6	-36.6	15.9
CP-44	10/5/1998	1110	-5.7	-30.9	14.9
CP-45	10/5/1998	1505	-5.3	-29.0	13.4
CP-46	10/6/1998	1020	-6.5	-40.3	11.6
CP-47	10/6/1998	1430	-5.7	-30.7	14.6
CP-48	10/7/1998	1027	-6.5	-38.3	13.7
CP-49	10/27/1998	1025	-6.5	-37.2	14.8
CP-50	10/28/1998	1205	-6.6	-38.7	14.2
CP-51	11/4/1998	1220	-6.7	-40.8	13.2
CP-51d	11/4/1998	1225	-6.7	-40.3	13.2
PD-01	6/28/1999	1435	-6.8	-40.6	13.8
PD-02	6/29/1999	1530	-6.7	-40.0	13.8
PD-03	6/30/1999	1030	-6.4	-37.2	13.6
PD-04	6/30/1999	1500	-7.0	-42.7	13.4

Table 17. Summary of oxygen ($\delta^{18}O$) and hydrogen ($\delta^{2}H$) isotopic data in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; per mil, parts per thousand; $\delta=((R_{sample}/R_{standard})-1)x1000$, where R is an isotope ratio; 2σ, 2 standard deviations; The 2σ precision of oxygen- and hydrogen-isotope results is 0.2 and 1.5 per mil, respectively. ***d***, deuterium excess; nd, not determined]

VAS no.	Date	Time	$\delta^{18}O$ (per mil)[1]	$\delta^{2}H$ (per mil)[1]	*d* (per mil)[2]
PD-05	7/1/1999	1240	-6.5	-39.1	13.2
PD-06	8/23/1999	1245	-7.1	-44.5	12.3
PD-07	8/23/1999	1515	-7.0	-42.7	13.3
PD-08	8/30/1999	1100	-6.5	-39.4	12.5
PD-09	8/31/1999	1045	-6.0	-34.0	13.9
PD-10	9/1/1999	1045	-6.6	-37.7	14.9
PD-11	9/1/1999	1350	-6.5	-37.3	14.9
PD-12	9/1/1999	1720	-5.8	-32.8	13.2
PD-13	9/2/1999	1030	-7.2	-42.7	15.2
PD-14	9/2/1999	1230	-7.2	-40.7	16.7
PD-15	9/2/1999	1545	-7.1	-41.9	14.7
PD-15d	9/2/1999	1550	-7.0	-38.1	17.9
PD-16	9/13/1999	1035	-6.9	-42.1	13.1
PD-17	9/13/1999	1448	-7.0	-41.9	14.5
PD-18	10/18/1999	1030	-6.1	-33.0	15.4
PD-19	10/19/1999	1130	-6.9	-40.5	15.0
PD-20	10/19/1999	1545	-7.1	-42.2	14.6
PD-20b	10/20/1999	800	nd	nd	nd
PD-21	10/25/1999	920	-7.0	-42.1	13.7
PD-22	10/25/1999	1240	-7.5	-44.1	15.9
PD-23	10/25/1999	1722	-7.0	-42.6	13.1
PD-24	10/26/1999	1324	-7.7	-46.5	15.1
PD-25	6/27/2000	1035	-6.7	-38.8	15.1
PD-26	6/27/2000	1500	-6.8	-39.2	15.2
PD-27	6/28/2000	920	-6.0	-34.8	13.4
PD-28	6/28/2000	1440	-6.3	-34.9	15.7
PD-29	6/29/2000	1130	-6.8	-40.0	14.1
PD-30	6/29/2000	1540	-6.7	-39.3	14.1
VB-01	5/13/1999	1615	-5.3	-29.1	13.2
VB-02	5/14/1999	1115	-5.7	-31.5	14.1
VB-03	5/10/1999	1830	-5.5	-30.4	13.4
VB-04	5/12/1999	1230	-5.8	-31.5	14.5
VB-05	8/14/2000	1415	-4.5	-22.7	13.6
VB-05b	8/14/2000	1410	nd	nd	nd
VB-06	8/11/2000	1000	-5.5	-30.6	13.4
VB-07	8/10/2000	1110	-4.6	-23.4	13.0
VB-08	8/9/2000	1130	-4.9	-24.4	14.5
VB-09	8/16/2000	1520	-4.6	-23.7	13.4
VB-10	8/17/2000	1045	-5.0	-26.3	13.4
VB-11	8/16/2000	945	-4.6	-25.4	11.7
VB-12	8/15/2000	1115	-5.7	-30.9	14.4
VB-13	8/8/2000	1225	-5.5	-30.7	13.0

Table 17. Summary of oxygen ($\delta^{18}O$) and hydrogen ($\delta^{2}H$) isotopic data in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; per mil, parts per thousand; $\delta=((R_{sample}/R_{standard})-1)x1000$, where R is an isotope ratio; 2σ, 2 standard deviations; The 2σ precision of oxygen- and hydrogen-isotope results is 0.2 and 1.5 per mil, respectively. ***d***, deuterium excess; nd, not determined]

VAS no.	Date	Time	$\delta^{18}O$ (per mil)[1]	$\delta^{2}H$ (per mil)[1]	*d* (per mil)[2]
VB-14	8/7/2000	1745	-5.5	-31.1	12.9
VB-14d	8/7/2000	1750	-5.5	-29.5	14.1
VR-01	7/6/1999	1230	-8.3	-53.9	12.6
VR-02	7/6/1999	1615	-8.2	-52.1	13.2
VR-03	7/7/1999	1035	-7.8	-47.2	15.2
VR-03d	7/7/1999	1040	-7.7	-47.9	13.5
VR-04	7/7/1999	1400	-7.9	-50.2	12.9
VR-05	7/8/1999	1015	-7.2	-44.2	13.4
VR-06	7/8/1999	1620	-8.1	-51.7	13.0
VR-07	7/8/1999	1820	-8.1	-51.8	13.2
VR-08	7/9/1999	1015	-8.1	-51.1	13.9
VR-09	7/9/1999	1300	-7.9	-52.2	11.2
VR-10	7/9/1999	1500	-8.1	-51.8	12.6
VR-11	7/9/1999	1645	-8.1	-52.9	12.2
VR-12	7/21/1999	945	-7.7	-51.3	10.6
VR-13	7/21/1999	1250	-7.7	-49.5	12.4
VR-14	7/22/1999	1200	-8.2	-51.5	14.1
VR-15	8/10/1999	1400	-8.1	-51.4	13.7
VR-15bt	8/10/1999	1405	nd	nd	nd
VR-16	8/11/1999	1330	-8.1	-51.3	13.2
VR-17	8/11/1999	1630	-8.1	-51.5	13.4
VR-18	8/12/1999	1130	-8.8	-57.0	13.7
VR-19	8/24/1999	1050	-7.3	-45.2	13.3
VR-20	8/24/1999	1315	-8.1	-48.1	17.0
VR-21	8/25/1999	1530	-7.5	-44.8	15.2
VR-22	8/26/1999	925	-7.7	-47.2	14.6
VR-23	8/26/1999	1400	-7.0	-40.5	15.9
VR-24	10/27/1999	925	-8.4	-53.2	13.9
VR-25	10/27/1999	1340	-8.3	-51.3	14.7
VR-26	10/28/1999	1010	-8.4	-49.8	17.4
VR-27	10/28/1999	1345	-8.0	-48.0	15.8
VR-28	7/12/2000	1415	-8.1	-49.0	15.5
VR-29	7/13/2000	1108	-7.2	-43.2	14.3
VR-30	7/13/2000	1415	-7.6	-47.7	13.4
VR-31	7/17/2000	950	-7.8	-50.1	12.5
VR-32	7/17/2000	1321	-7.7	-48.9	13.0
VR-33	7/18/2000	1030	-7.7	-49.7	11.5
VR-34	7/18/2000	1400	-7.6	-47.1	13.6
VR-35	7/19/2000	915	-8.4	-54.3	13.2
VR-35b	7/19/2000	1000	nd	nd	nd
VR-36	7/20/2000	1430	-7.7	-48.3	13.4
VR-37	7/17/2000	950	-8.1	-52.8	12.2

Table 17. Summary of oxygen ($\delta^{18}O$) and hydrogen ($\delta^{2}H$) isotopic data in water samples from wells and springs in Virginia, 1998-2000—Continued

[VAS, Virginia Aquifer Susceptibility study; per mil, parts per thousand; $\delta=((R_{sample}/R_{standard})-1)x1000$, where R is an isotope ratio; 2σ, 2 standard deviations; The 2σ precision of oxygen- and hydrogen-isotope results is 0.2 and 1.5 per mil, respectively. ***d***, deuterium excess; nd, not determined]

VAS no.	Date	Time	$\delta^{18}O$ (per mil)[1]	$\delta^{2}H$ (per mil)[1]	*d* (per mil)[2]
VR-37d	7/17/2000	955	-8.1	-51.1	13.9
VR-38	7/18/2000	915	-7.5	-46.5	13.4
VR-39	7/18/2000	1330	-7.9	-50.0	13.4
VR-40	7/19/2000	925	-7.8	-48.7	13.5
VR-41	7/19/2000	1125	-7.8	-47.0	15.1
VR-42	7/20/2000	1200	-8.5	-50.6	17.3
VR-42bt	7/20/2000	1205	nd	nd	nd
VR-43	7/20/2000	1740	-8.7	-54.8	14.5
VR-44	7/20/2000	900	-8.7	-51.8	18.0
VR-45	7/25/2000	920	-8.2	-51.3	14.2
VR-46	7/25/2000	1310	-8.1	-48.8	15.7
VR-47	7/26/2000	1015	-7.7	-47.7	13.6
VTDW-01	9/16/1999	1505	-7.7	-47.6	14.3
VTDW-03A	7/15/2000	1300	-7.8	-45.7	16.6
VTDW-03B	7/15/2000	1700	-7.8	-45.9	16.5
VTDW-07A	7/14/2000	1430	-7.8	-46.4	15.9
VTDW-07B	7/14/2000	1610	-7.8	-47.0	15.5
VTDW-08	9/16/1999	1800	-7.6	-45.9	14.9

[1]$\delta^{18}O$ and $\delta^{2}H$ were determined on water samples at the U.S. Geological Survey Stable Isotope Laboratory, Reston, Va. The stable isotope results are reported in per mil relative to VSMOW (Vienna Standard Mean Ocean Water; Coplen, 1996) and normalized (Coplen, 1988) on scales such that the oxygen and hydrogen isotopic values of SLAP (Standard Light Antarctic Precipitation) are -55.5 and -428 per mil, respectively.

[2]Deuterium excess is defined as $d = d\delta^{2}H - 8\delta^{18}O$ by Clark and Fritz (1997).

Table 18. Summary statistics of relative percent difference between analytical data for original and duplicate water samples from wells and springs in Virginia, 1998-2000

[mg/L, milligrams per liter; pCi/L, picocuries per liter; 2σ, 2 standard deviations; mg/L, micrograms per liter; cc_{STP}/g, cubic centimeters at standard temperature and pressure per gram; TU, tritium unit, 1 TU=1 atom of ^3H in 10^{18} atoms of H; He, helium, Ne, neon, Δ^4He (%), percentage of ^4He greater than solubility equilibrium concentration; $\delta^3He=((R_{sample}/R_{air})-1)x100$; R is the ratio $^3He/^4He$; $R_{air}=1.384x10^{-6}$; ΔNe (%), percentage of Ne greater than solubility equilibrium concentration]

Constituent	Measurement units	Number of samples	Relative percent difference		
			Minimum	Median	Maximum
Major-element chemistry (table 7)					
Calcium	mg/L	9	0.4	0.7	12.5
Magnesium	mg/L	9	0.0	0.3	1.9
Sodium	mg/L	9	0.0	1.0	3.9
Potassium	mg/L	9	0.0	1.7	8.0
Chloride	mg/L	9	0.0	0.5	4.3
Sulfate	mg/L	9	0.0	0.2	2.0
Bicarbonate, lab	mg/L	9	0.0	0.2	2.2
Minor-element chemistry (table 8)					
Strontium	mg/L	8	0.0	0.7	4.4
Silica	mg/L	9	0.0	0.9	1.0
Iron	mg/L	9	0.0	0.5	8.6
Manganese	mg/L	9	0.0	0.9	66.7
Fluoride	mg/L	9	0.0	0.0	6.5
Nitrate (NO_2+NO_3)	mg/L as N	9	0.0	0.0	1.6
Dissolved organic carbon	mg/L	9	0.0	7.2	133.3
Radon-222	pCi/L	9	0.3	3.5	74.1
Radon-222, 2σ error	pCi/L	9	0.0	0.0	5.4
Trace-element chemistry (table 9)					
Aluminum	mg/L	8	0.0	0.0	12.6
Boron	mg/L	8	0.0	0.9	28.6
Barium	mg/L	8	0.0	1.1	2.6
Bromide	mg/L	9	0.0	0.0	22.2
Lithium	mg/L	8	0.0	0.4	7.0
Zinc	µg/L	8	0.0	6.0	85.7
Lead	µg/L	8	0.0	9.8	46.2
Copper	µg/L	8	0.0	13.6	66.7
Nickel	µg/L	8	0.0	1.0	66.7
Rubidium	µg/L	8	0.0	0.3	2.6
Vanadium	µg/L	8	0.0	0.0	45.5
Dissolved gas compositions (table 10)					
Nitrogen	mg/L	10	0.0	0.4	5.4
Argon	mg/L	10	0.2	0.5	2.5
Oxygen, lab	mg/L	10	0.2	3.3	52.1
Carbon dioxide	mg/L	10	0.0	1.4	7.2
Methane	mg/L	10	0.0	1.1	7.5
Neon	cc_{STP}/g	3	0.1	0.9	2.4
Tritium, dissolved helium, and neon (table 15)					
Tritium	TU	10	0.0	0.0	19.2
Tritium, 2σ error	±TU	10	0.0	0.0	27.1
Helium-4	cc_{STP}/g	3	0.0	2.5	3.2
Δ^4He	%	3	0.1	5.9	6.4
δ^3He	%	3	0.1	2.3	7.7
Ne	cc_{STP}/g	3	0.1	0.9	2.4
Ne	%	3	0.1	5.8	13.2
Terrigenic helium	%	3	1.5	10	20.2

Table 19. Summary statistics of analytical data for blank water quality assurance samples, 1998-2000

[mg/L, milligrams per liter; mg/L, micrograms per liter; <, actual value is known to be less than value shown]

Constituent	Measurement units	Number of samples	Concentration		
			Minimum	Median	Maximum
Major-element chemistry (table 7)					
Calcium	mg/L	6	<0.1	<0.1	0.3
Magnesium	mg/L	6	<0.05	<0.05	0.03
Sodium	mg/L	6	<0.05	<0.1	1.07
Potassium	mg/L	6	<0.1	<0.1	0.4
Chloride	mg/L	6	<0.1	<0.2	<0.3
Sulfate	mg/L	6	<0.1	<0.2	<0.3
Bicarbonate, lab	mg/L	6	<1.0	<1.0	3.5
Minor-element chemistry (table 8)					
Strontium	mg/L	6	<0.005	<0.001	<0.001
Silica	mg/L	6	0	0.1	1.2
Iron	mg/L	6	<0.01	<0.02	<0.02
Manganese	mg/L	6	<0.001	<0.001	0.002
Fluoride	mg/L	6	<0.1	<0.1	<0.1
Nitrate (NO_2+NO_3)	mg/L as N	6	<0.005	<0.05	<0.05
Dissolved organic carbon	mg/L	6	<0.1	<0.3	0.7
Trace-element chemistry (table 9)					
Aluminum	mg/L	5	<0.001	0.006	0.01
Boron	mg/L	5	<0.02	<0.02	0.06
Barium	mg/L	5	<0.001	<0.001	<0.001
Bromide	mg/L	5	<0.02	<0.05	0.01
Lithium	mg/L	5	<0.001	<0.001	<0.001
Zinc	µg/L	5	2	3	7
Lead	µg/L	5	<0.05	0.13	0.26
Copper	µg/L	5	0.4	0.5	2.1
Nickel	µg/L	5	<0.1	<0.1	0.1
Rubidium	µg/L	5	<0.1	<0.1	<0.1
Vanadium	µg/L	5	<0.1	<0.1	<1.0